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SURGERY, GYNECOLOGY AND OBSTETRICS

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THE ANAL SPHINCTER AND THE PATHOGENESIS OF ANAL FISSURE AND FISTULA[1]

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THE stimulus for this work was furnished by the following interrogations of Prof. A. V. Moschcowitz based on his clinical observations: (1) Why do the usual descriptions of the external anal sphincter picture the muscle as attaching to the tip of the coccyx, when on palpation one feels it arising from the sides of the coccyx and extending forward to surround the anus as two lateral bands? (2) Why is the internal opening of the majority of anal fistulæ constantly found just within the anocutaneous junction at a point corresponding to 5 or 7 on the clock, considering the posterior median line as 6 o'clock?

The latter observation is by no means wholly original. From the comprehensive clinical works of Esmarch and Quénu and Hartman, one learns that Ribes, in 1820, noted that the internal orifice of an anal fistula is usually just above the anocutaneous junction, exceptionally 10 to 12 millimeters above this level. It corresponds precisely with the zone of the semilunar valves, a zone easily inoculable by virtue of the structure of the mucous membrane and its richness in lymphatic vessels. Velpeau confirmed the work of Ribes. "In 35 autopsies of fistula, he found the internal orifice in 4 cases at 38 millimeters, at 63 millimeters from the anus, in one case 76 millimeters, and in 300 (?) a few millimeters."[2]

Esmarch, in 1887, noted that in most cases the fistulæ pass through the musculature of the sphincter; they seldom pass above the internal sphincter; and even less frequently are the fistulæ very superficial with an opening distal to the musculature of the sphincter, hair-breadth in size, when they are known as subcutaneous fistulæ or "fistulettes." In 1890, however, Reclus, quoted by Frey (22), found subcutaneo-submucous fistulæ much more common than fistulæ communicating with the ischiorectal fossa. The latter observation has been subsequently substantiated by most investigators. In 1887, Mr. Swinford Edwards "pointed out that there seemed to be a definite relation between the internal and external orifices of a fistula. For fistulæ having their external orifices situated behind a plane passing transversely through the center of the anus usually have their internal aperture in the middle line dorsally, while those with their external orifice in front of this plane generally terminate in an internal opening immediately opposite, thus forming a simple, straight, complete fistula." DaCosta quotes Tuttle to the effect that in *subcutaneous* fistula the *external* opening is usually within one inch of the anus, and the *internal* opening is usually external to Hilton's white line. The channel joining the openings is usually straight, but may encircle the anus. In *submuscular* fistula, the *internal* opening is

[2] Translated literally from Quénu and Hartman, p. 162. The 300 probably should be 30.

[1] From the Senckenberg Institute for Pathology, University of Frankfurt.

usually between the sphincters. The *external* opening is an inch or more from the anus. Rotter and Davis also located the internal opening of submuscular fistulæ between the two sphincters, whereas Quénu and Hartman found it above both sphincters. Among the works of modern proctologists, the following statements are found. Hirschman: "The most common location of the internal opening of a fistula is at the posterior commissure of the anus between the sphincter muscles." Mummery: "In the majority of cases they will be found to communicate at some point behind the anus, and from this communication a track will be found passing into the bowel posteriorly." Gant: "In 95 per cent of fistulæ, the opening is located in the posterior median line at the sphincter juncture, whether the sinus travels upward or downward or around the rectum. In other instances fistulæ may penetrate the anal, middle, or upper rectum, or the sphincter muscle, but usually they enter the anal canal one-half inch above the anus, posteriorly in the median line." From this review, one gains the impression that the more recent writers recognize the posterior location of the internal opening of the majority of anal fistulæ, although no explanation is offered for the constancy of this phenomenon and a specific posterior point aside from the median line is not designated. Parenthetically, it is worthy of note that the *external* openings of fistulæ are usually laterally located, except, as noted by Delbet and Melchior, in cases due to syphilis, rectum carcinoma, or osteomyelitis, although Frey has found exceptions to these observations.

A proper reply to the first query of Prof. A. V. Moschcowitz involves a complete study of the anal sphincters. One only realizes the necessity for such a study after a thorough review of the literature on the subject, when he finds a few fundamental and careful studies counterbalanced by a whole series of generalities. From an historical point of interest, Holl states that the first studies of any importance of the sphincteric musculature of the anus were made by Santorini. The following description from Quain's *Anatomy* (55), in 1834, gives one an idea of the earlier conceptions of the sphincteric musculature: "m. sphincter ani externus (coccygeo-analis) is a flat elliptic muscle placed immediately beneath the skin surrounding the margin of the anus. It is attached posteriorly to the coccyx by a narrow fasiculus of tendinous fibers, and anteriorly becomes blended, about midway between the anus and the bulb, through the medium of a common fibrous point, with the transversi and acceleratores muscles, whilst the intervening part is disposed like orbicular muscles elsewhere, being composed of fleshy fibers curving round the intestine, and united by commissures before and behind it. One surface of the muscle is covered by the skin, the other rests on the internal sphincter, and on some cellular tissue which separates it from the levator ani. . . . m. sphincter ani internus is a flat muscular ring, surrounding the anal extremity of the rectum; it is about four or five lines in breadth, and two thick. It obviously consists of the circular fibers of the intestine much more developed than elsewhere, and projecting lower down than the longitudinal fibers." In 1853, Treitz amplified the description by discovering the rectococcygeus muscle which bears his name and which consists of augmented longitudinal bowel muscle from the posterior surface of the rectum and anus extending to the coccyx and fixing the rectum. In 1858, Béraud described the same muscle under the name of "M. suspenseur du rectum." Luschka, 1864, described the external sphincter as consisting of "Hautmuskel" extending anteriorly and posteriorly to the anus and attaching to the fourth coccygeal vertebra. In 1874, Robin and Cadiat carefully studied the relationship of the longitudinal bowel fibers with relation to the sphincter muscles. Their description did not agree with that of Henle, who believed that the longitudinal fibers did not extend beyond the levator ani muscle. In 1881, C. Roux made a careful study of the anal musculature. Figure 14 represents a summary of his results. The most superficial fibers, "Hautmuskel" of Luschka, or "Sphincter superficiel" of Cruveilhier, attach to the skin anterior and posterior to the anus. The second and larger group, "Sphincter profond" of Cruveilhier, arises from the dorsum of the tip of the coccyx; its fibers then cross before surrounding the anus

to end in the centrum tendineum perinei, or to join musculus bulbocavernosus or musculus transversus perinei superficialis. Contrary to the conception of Henle, he found no fibers to the latter two muscles which did not cross in the midline anterior to the anus. He further described the deepest fibers as surrounding the rectum in unbroken rings. His description of the smooth muscle fibers of the longitudinal bowel coat and muscularis mucosæ with regard to their relations to the sphincter muscles greatly elaborates the work of Robin and Cadiat; he described the longitudinal muscle fibers as extending to the skin. Gegenbaur, 1890, demonstrated that fibers do pass to musculus bulbocavernosus or musculus sphincter vaginæ of the same side almost constantly. He further described musculus sphincter externus as consisting of layers which embrace the lower bowel partly laterally, partly anteriorly, and partly posteriorly. One of the best studies of this subject was made by Holl, 1897. He divided the external sphincter into subcutaneous, superficial, and profundus layers. The subcutaneous layer is attached largely to the skin and begins with crossed fibers posterior to the anus and ends in the same manner anterior to the anus. The fibers may extend so far anterior as to form a musculus retractor scroti as commonly found in the cat. The superficial layer may arise from the skin but more commonly from the dorsal aspect of the coccyx through fibrous attachments. Some fibers cross posterior to the anus and then the whole layer extends around the anus anteriorly to the superficial fascia, centrum tendineum perinei, or to musculus bulbocavernosus of the same side. The profundus layer forms a ring around the rectum but the fibers are not unbroken as described by Roux but crossed anteriorly and posteriorly. The fibers which appear to enter the profundus layer from the musculus bulbocavernosus and musculus transversus perinei superficialis of the same side are found on closer examination actually to be fibers of the superficialis layer which pass into the musculus bulbocavernosus or insert on the tuberosity of the ischium and then appear to be a part of musculus transversus perinei. He finds analogies for the various layers in the cat and rabbit. The profundus layer corresponds with the "sphincter internus" of Strauss-Durckheim found in carnivores, whereas the homologue of both the subcutaneous and superficialis layers consists of a muscle which arises from the dorsum of the root of the tail and in the rabbit surrounds the root of the tail, rectum, and penis in the fashion of a sling to insert into the skin of the dorsum of the penis and the corpus cavernosum penis. Fibers of the latter muscle arise from the corpus cavernosum penis and after surrounding the anus unite behind it. In addition, he describes a muscle, the musculus puborectalis or musculus sphincter recti, which encircles the anus deep to the musculus sphincter ani externus and superficial to the pubococcygeal division of the musculus levator ani. This musculus puborectalis arises from the os pubis and deep surface of the urogenital diaphragm and after encircling the anus inserts into the corresponding structures of the opposite side. Fibers from it enter the musculus transversus perinei superficialis of the opposite side, the musculus sphincter ani externus, and others after becoming tendinous accompany the longitudinal muscle fibers of the anterior surface of the bowel to the centrum tendineum perinei or the skin surrounding the anal outlet. This muscle is separated from the external anal sphincter by the inferior hæmorrhoidal vessels and the projections of obturator fascia which accompany them. Smooth muscle fibers do not extend as such to the skin, but their tendinous fibro-elastic extensions pass between and through the sphincter muscles to the skin.

The works of Robin and Cadiat, Roux, and Holl constitute the basis for most of the other descriptions found. Esmarch, Piersol, Cunningham, Waldeyer, Langer-Toldt, Spalteholz, and Braus still refer to the deep fibers of the musculus sphincter ani externus as ring-shaped, although Spalteholz does add that there are crossed fibers anteriorly and posteriorly. Hirschman refers to longitudinal or elliptical fibers and circular fibers. "The circular fibers are most superficial, entirely surrounding the anal canal." In Davis' *Applied Anatomy*, the muscle is described as follows: "The external sphincter surrounds

the lower part of the canal and stretches in a spindle shape from the tip of the coccyx to the central point or tendon of the perineum. Anteriorly, it blends with the fibers of the levator ani and other muscles of the perineum. It is a thick, powerful, voluntary muscle and extends outward from the white line of Hilton or mucocutaneous junction." The latter description finds many subscribers, although some of them add that the fibers cross posteriorly or anteriorly to the anus and send fibers to the musculus bulbocavernosus and musculus transversus perinei superficialis. Corning, Rauber-Kopsch, Testut and Jacob, Tandler, Landsman, Gant, and Mummery are among this group.

Ellenberger and Baum and Martin describe the anal muscles in tailed mammals as being largely suspended from the dorsum and sides of the vertebræ of the tail at its base. Waldeyer, Langer-Toldt, Braus, Corning, Rauber-Kopsch, Testut and Jacob, and Davis describe the external anal sphincter in man as arising from the *lip* of the coccyx. A study of the comparative anatomy of the coccyx shows it to be a rudiment of the tail. In fact Lartschneider was able to find all of the tail muscles represented in man. A more grotesque situation than anal musculature arising from the end of the vertebral column in tailed mammals could hardly be conceived. It seems unlikely, therefore, that in man an homologous point of attachment should be selected.

A short review of the experimental physiological and neurological work performed on the anal sphincter is also essential as a basis for this study.

Langley and Anderson (34–38), in a very extensive study on cats and rabbits, and v. Frankl-Hochwart and Froehlich on dogs, found two sets of vegetative nerves to the rectum and anus. The first, the hypogastric nerves, consists of fibers arising from the lumbar sympathetic, first to fifth lumbars, passing through the paravertebral sympathetic chain via the white rami to the inferior mesenteric ganglion, from which point they assume their identity, to pass into the pelvis to join the second set, nervi erigentes, or nervi pelvici of Langley and Anderson, to form the pelvic plexus. The nervi erigentes arise from the first, third, and principally second sacral nerves. The external sphincter receives its innervation through peripheral nerves by way of the internal pudendal nerve.

The exact effects of each of these nerves has not been definitely concluded. The effects seem to vary in various animals. In the cat, Langley and Anderson, and in the dog, v. Frankl-Hochwart and Froehlich, produced contraction of the whole terminal end of the intestine, circular and longitudinal fibers, plus contraction of the sphincters by stimulation of the nervi erigentes. The degree of their constricting effect was shown by the fact that dilatation by stimulation of the nervi hypogastrici in dogs was only consistently produced, 9 out of 12 times, by v. Frankl-Hochwart and Froehlich, after the nervi erigentes had been completely removed. Stimulation of the nervi hypogastrici in cats and rabbits, however, produced variable effects in the hands of Langley and Anderson.

A review of this subject by Westphal discloses work establishing centers for anal control in the bowel wall itself (plexuses of Meissner and Auerbach), in neighboring plexus ganglia, in the lowest lumbar and upper sacral segments of the spinal cord, in the second and third lumbar segments of the spinal cord, in the region of the optic thalamus, and in the cerebrum in the region of the sulcus cruciatus. Through the spinal and cranial centers, psychic and peripheral nerve-stimulating effects manifest their influence on continence.

Stimulation of the nervus hæmorrhoidalis medius of the dog, corresponding to the inferior hæmorrhoidal nerve of man, causes energetic closure of the anus. Cutting of this nerve causes wide anal relaxation at first, followed by a lessening of the degree of this relaxation. Defæcation becomes difficult because the sensory nerve reflexes which travel through the internal pudendal nerve are obliterated (Westphal). If the nervi hypogastrici and nervi erigentes are both cut, paralysis of the sphincters but also a continued urgency to stool appears, often not until 2 or 3 days, abating only after weeks or after the internal pudendal nerves are cut (Lewandowsky and Schulz; and Deunig). When all of the

nerves are cut, voluntary control disappears because of the loss of the feeling of fullness carried by the internal pudendal nerves necessary to stimulate defæcation. Goltz and Ewald studied the external anal sphincter after complete destruction of the lumbar and sacral spinal cord in the dog. The internal sphincter regained its tonus, whereas the external sphincter remained paralyzed, although it gave no reactions of degeneration and remained responsive to electrical stimulation in animals that outlive the operation for a considerable time after all the other skeletal muscles have ceased to react. According to Westphal, Arloing and Chantre demonstrated that 11 months after the destruction of its supplying sacral nerves, the external sphincter muscle did not change histologically but manifested twitching reactions somewhat similar to smooth muscle. Von Frankl-Hochwart and Froehlich found that after an animal had been poisoned by curare, the external anal sphincter continued to react to stimulation long after the other striated muscles had become irresponsive. Recently Beck, by electromyographic methods, concluded that the sphincter musculature, without specific differentiation of muscles, possesses tonus which returns within a definite period after dilatation. Because of its immunity to curare and because of its reaction as a whole on electrical stimulation, the external anal sphincter, too, has been conceived to possess nerve centers similar to those of the myenteric plexus of Auerbach.

The work of Matti throws a new light on the inter-relationship of the internal and external anal sphincters and clarifies with simplicity their actions during defæcation. He demonstrated on dogs that if the external anal sphincter be cut bilaterally the internal sphincter keeps the anus closed unless the finger is introduced into the anus when the muscle relaxes after about 15 or 20 seconds and fails to regain its tonus. The internal sphincter then responds peristaltically as a part of the rectum and about one-half centimeter of mucous membrane becomes visible. When, however, the external sphincter is repaired, the internal sphincter assists in closing the anus through the mechanical, not reflex, stimulation of its intramuscular plexus by the persistent tonus of the external sphincter. The visible mucous membrane disappears from view and the grip is maintained on the palpating finger indefinitely. The return of anal tonus about one month after the removal of all extrinsic anal innervation is attributed by Matti to the fibrosis and shrinking which accompanies the atrophy of the external sphincter fibers. The internal sphincter becomes grasped in the shrunken external sphincter and as a result of mechanical stimulation regains its tonus.

METHODS OF INVESTIGATION

The greatest difficulties and inaccuracies in tracing muscle fibers have probably arisen from the use of fixed anatomical material. In this study, fresh anatomical material was used for all gross work. Twelve adults and one child of 8 years were used for the study of the muscles and fascia. The coccyx, perineum, and pelvic organs were removed *en masse* and then the vessels, fascia, and muscle fibers were prepared. The arteries in 5 of these specimens were injected with a gelatine-dye solution before removal of the specimen from the body. When doubt existed as to whether a muscle were smooth or striated, a small piece was removed and examined. Several newborn infants were also injected and dissected. In the latter instances the entire pelvis was frequently removed instead of the perineum and pelvic organs. Microscopic studies of the musculature stained with hematoxylin-eosin, and by Van Gieson and elastic tissue stains were made in specimens from the infants and from a female aged 4 years. Microscopic nerve study in the infants was unsatisfactory but good preparations were obtained from the adults by the Bielschowsky technique on teased tissue and frozen sections.

All striated muscle fibers in the anal triangle superficial to the level of the urogenital diaphragm and the level at which the inferior hæmorrhoidal vessels pierce the striated muscle sheath of the anus as they extend from the ischiorectal fossa, were considered as the external sphincter ani muscle. Likewise, the muscular fibers passing from and to the anococcygeal raphe superficial to the posterior

space connecting the ischiorectal fossæ were considered as part of the musculus sphincter ani externus. In several of the specimens, the demarcation between this muscle and levator ani muscle was very difficult.

RESULTS

A. Muscles. The results of the study of the sphincter musculature are shown in Figures 1 to 13 inclusive. They may be summarized as follows:

1. The *superficial* fibers of the musculus sphincter ani externus (a) may extend anteriorly and posteriorly on each side of the anus as shown in Specimen 1 in which the fibers cross anteriorly to enter the musculus sphincter vaginæ; in Specimen 2, in which crossed and uncrossed fibers pass anteriorly to musculus sphincter vaginæ; perineal scar, in Specimens 3, 4, and 5; in Specimen 12, perineal scar: (b) may simply surround the anus posteriorly, arising and ending in the region of the centrum tendineum perinei, as shown in Specimen 13; in Specimen 9, in which crossed and uncrossed fibers pass anteriorly to centrum tendineum perinei and musculus sphincter vaginæ: (c) may consist of both of the foregoing types, as in Specimen 8, in which uncrossed fibers pass anteriorly to musculus transversus perinei superficialis, in Specimen 4: (d) or, the superficial fibers may encircle the anus anteriorly plus fibers which extend anteriorly and posteriorly, as in Specimen 7, in which crossed and uncrossed fibers pass anteriorly to musculus sphincter vaginæ; perineal scar, or as in Specimen 10. The most superficial fibers of this layer attach to the skin anteriorly and posteriorly to the anus.

2. The deeper layer of the musculus sphincter ani externus may consist (a) largely of fibers which encircle the anus posteriorly, as in Specimen 1, in which crossed and uncrossed fibers pass anteriorly to the musculus sphincter vaginæ and the musculus transversus perinei superficialis. One small group associated with the internal sphincter posteriorly encircles the anus anteriorly, in Specimen 2, perineal scar; in Specimen 4, in which are fibers to the centrum tendineum perinei plus crossed and uncrossed fibers anteriorly to the musculus bulbocavernosus and musculus transversus perinei superficialis; in Specimen 10, in which crossed and uncrossed fibers pass anteriorly to the musculus sphincter vaginæ and the musculus transversus perinei superficialis; posteriorly, marked communications with longitudinal bowel coat and fibers passing laterally to the musculus levator ani; in Specimen 11, in which crossed and uncrossed fibers pass anteriorly to the musculus bulbocavernosus and the musculus transversus perinei superficialis. Fibers pass posteriorly to the musculus levator ani; in Specimen 12 crossed and uncrossed fibers pass anteriorly to the musculus sphincter vaginæ and the musculus transversus perinei superficialis. Posteriorly, fibers pass to the musculus levator ani; in Specimen 13, in which are fibers to the centrum tendineum perinei plus crossed and uncrossed fibers anteriorly to the musculus transversus perinei superficialis: (b) of fibers which encircle the anus anteriorly, as in Specimens 5 and 6, in which a very few fibers pass into the centrum tendineum perinei and some cross into the musculus transversus perinei superficialis of the opposite side: (c) of fibers which encircle the anus posteriorly plus fibers which encircle the anus anteriorly, as in Specimen 3, in which there are a few anterior encircling fibers, posterior encircling fibers which extend to the centrum tendineum perinei or cross anteriorly to enter the musculus levator ani, musculus transversus perinei superficialis or the musculus bulbocavernosus, and uncrossed to the musculus bulbocavernosus: (d) of fibers which encircle the anus posteriorly plus fibers which extend anteriorly and posteriorly, as in Specimen 8, in which there is distortion of fibers in the perineum due to scar: (e) of fibers which encircle the anus anteriorly plus a greater number of anteroposterior fibers, as in Specimen 9: (f) of fibers which neither encircle the anus anteriorly or posteriorly but cross anteriorly or posteriorly to produce the condition shown in Specimen 7, perineal scar. The close inter-relationship between the superficial and deep fibers of the external anal sphincter are shown in Specimen 10.

3. The internal sphincter ani muscle varied in thickness from 0.5 millimeter to 3 millimeters; and in width from 3 millimeters to 2

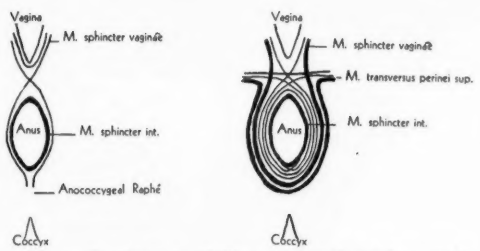

Fig. 1. Specimen 1. Nulliparous female aged 19 years. Death from pulmonary tuberculosis. Left figure: the very superficial fibers of the sphincter ani externus, only about two or three in number, pass from the anococcygeal raphe around the anus to the musculus sphincter vaginæ of the opposite side. Right figure: the deeper fibers of the sphincter ani externus constitute the main group and consist of fibers encircling the anus posteriorly from and to the musculus transversus perinei superficialis and the musculus sphincter vaginæ. Some fibers cross anterior to the anus. A few fibers of the deep layer encircle the anus anteriorly and are associated with the longitudinal bowel fibers posteriorly. The anococcygeal raphe is poorly developed, consisting only of a fibrous band and a few superficial muscle fibers. A few muscle fibers extend from its deep surface to levator ani of each side. A posterior communicating space between the ischiorectal fossæ is present. The sphincter ani internus is 2 millimeters thick and 3 millimeters wide. The musculus transversus perinei superficialis is well developed and consists of fibers extending directly across the midline plus fibers received from the musculus sphincter ani externus. The musculus sphincter vaginæ also had independent fibers in addition to those received from the external anal sphincter. Terminations of longitudinal bowel fibers are numerous at the anterior and posterior commissures but form only a thin layer laterally.

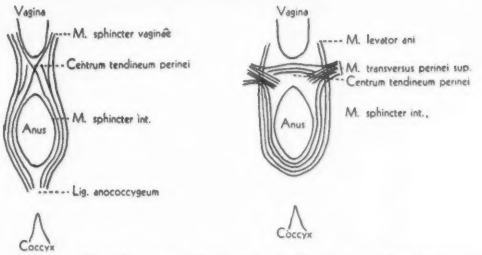

Fig. 2. Specimen 2. Female aged 67 years. Death from carcinoma of the pancreas. Left figure: superficial fibers of the sphincter ani externus. Right figure: deep fibers of the musculus sphincter ani externus with a few fibers of the levator ani muscle. Anterior to the anus is a cicatrix probably the result of an intrapartum laceration. The anococcygeal raphe is well developed and a posterior communicating space between the ischiorectal fossæ is present. The musculus transversus perinei superficialis is well developed and some of its fibers crossing the midline appear to have escaped injury. The terminations of the longitudinal bowel fibers attaching to the skin are very numerous.

centimeters. The muscle is formed by a heaping up of the terminal circular fibers of the bowel. It can usually be palpated as a distinct band, although in Specimen 4 the fibers did not form a complete circle. Of the specimens examined, the muscle seemed more prominent in the females than in the males.

4. The longitudinal muscle fibers of the bowel terminate as fibro-elastic extensions which traverse external and internal sphincter ani muscles as described by Robin and Cadiat and Holl, and not as smooth muscle fibers as described by Roux, Cunningham, Piersol, Gant, Waldeyer, and others. The fibro-elastic terminations which traverse the internal sphincter muscle to join the terminations of the muscularis mucosæ insert partly into the uncornified stratified squamous epithelium between the mucous membrane area and the cornified skin region. Part of these fibers pass around the superficial surface of the internal sphincter ani to intermingle with the fibro-elastic terminations of the longitudinal layer which pass between the two anal sphincters on their way to the cornified skin at the margin of the anus. In this manner the internal sphincter ani is almost completely covered on its superficial, medial, and lateral surfaces by fibro-elastic terminations, most numerous in the anterior and posterior commissures and least numerous in the posterolateral quadrants (see Fig. 3, A). In fact sections through the posterolateral quadrants disclose a marked deficiency of these fibers especially where the inferior hæmorrhoidal vessels pass to the submucous layer. Anteriorly and posteriorly the fibro-elastic terminations pass to the centrum tendineum perinei and ligamentum anococcygeum respectively. Smooth muscle fibers as such were observed passing into the levator ani muscle, the superficial transverse perineal muscle, the external sphincter ani, and the rectococcygeus muscle.

5. The rectococcygeus muscle was present in all specimens examined. No attempt was made to determine the presence of striated muscle fibers in this muscle as maintained by Roux.

6. The tail muscles as described by Lartschneider, aside from the levator ani muscle, were not studied. These muscles are the coccygeus, the levator ani, the sacrococcygeus anterior, the sacrococcygeus posterior,

and the group of smooth muscle fibers lying upon the rectococcygeus muscle of Treitz corresponding to the "Afterschweifband" in tailed mammals.

7. The anococcygeal raphe was studied with relation to the sphincter ani externus muscle. The fibrous extensions of this muscle were found to extend over the dorsum to the sides of the coccyx. Between the dorsum of the coccyx and the ligamentous extensions of the external anal sphincter, the bursa described by Luschka was constantly found. The termination of the middle sacral artery was found to pass dorsalward through a small hiatus distal to the tip of the coccyx. No attachments of the sphincter ani to the tip of the coccyx were found. In Specimens 1, 8, 9, and 12 the anococcygeal raphe was poorly developed, and in Specimen 8, it was almost insignificant.

B. Fascia. The ischiorectal fossa was found to be lined with the fascia covering the superficial surfaces of obturator internus and levator ani muscles. This fascia is continuous with the fascia covering the gluteal muscles laterally, Colles's fascia or the superficial fascia of the superficial perineal space, and the fascia covering the deep surface of the urogenital triangle, deep to which is found the pubic extension of the ischiorectal fossa described by Waldeyer. On the medial surface of the ischiorectal fossa the fascia may extend as far superficial as the outer margin of the external sphincter ani. The inferior hæmorrhoidal vessels and nerves pass through the ischiorectal fossa accompanied by an exceedingly thin fascial sheath which extends from the point where they pierce the obturator fascia covering Alcock's canal to the points where they pierce the fascial covering of the medial surface of the ischiorectal fossa. Between the ischiorectal fossæ posteriorly is a fat filled space by means of which the fossæ can communicate by rupturing an almost insignificantly thin fascial layer. The same communicating possibilities existed anteriorly in Specimens 5 and 6. In Specimen 9 the posterior communication lay superficial to the anococcygeal raphe, whereas, in all of the other specimens it was found deep to that structure.

C. Arteries. In general, the distribution of the hæmorrhoidal arteries in the specimens conformed with the description of Cunningham, namely: "The inferior hæmorrhoidal artery is distributed chiefly on the posterior, and the middle hæmorrhoidal chiefly on the anterior aspect of the lower part of the bowel." This is true for the anal canal excepting the anal sphincter region where the anterior two-thirds of the sphincter muscles and anal outlet were found to be supplied by the perineal artery, anastomosing above with the middle hæmorrhoidal artery, which in turn anastomosed above with the superior hæmorrhoidal artery; whereas, the posterior third of the sphincter muscles and anal outlet were found to be supplied by the inferior hæmorrhoidal artery, anastomosing above with the superior hæmorrhoidal artery. The termination of the middle sacral artery, the important tail artery of tailed mammals, was found in the anococcygeal raphe; therefore, it plays no direct part in the blood supply of the sphincters and anal canal. The perineal artery was found to leave the internal pudendal artery and pass medialward in the superficial perineal space, as described in Davis' *Applied Anatomy*. In this manner the perineal artery reached the sphincter muscles and anal region passing into a fascial fold pictured by Rauber, essentially isolated from the ischiorectal fossa.

The detailed distribution of the inferior hæmorrhoidal artery and the perineal artery was found to be as follows (see Figure 15):

1. The artery of the perineum divided into two main branches in the superficial perineal space: (a) The anterior of these two branches passed medially at a very slight angle and divided into: (1) four or five small branches to the longitudinal bowel coat; (2) one branch which passed through the longitudinal bowel coat to appear on the mucous surface superficial to the internal sphincter. (b) The posterior of these branches passed medially at a slightly greater posterior angle and divided into: (1) a branch which passed posteriorly in the deepest layer of the external sphincter to anastomose with a branch from the inferior hæmorrhoidal artery; (2) several fine branches to the superficial layers of the external sphincter in its anterior two-thirds; (3) a branch

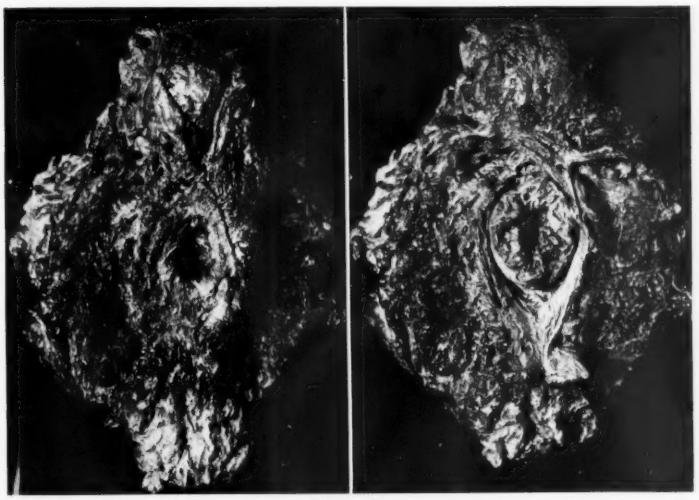

Fig. 3 A

Fig. 3. Specimen 3. Male aged 50 years. Death from peri-arteritis nodosa. Left figure: superficial fibers of the sphincter ani externus. Right figure: deep fibers of the sphincter ani externus. A very small number of fibers encircle the anus anteriorly and extend posteriorly to the anococcygeal raphe. Most of the fibers encircle the anus posteriorly and extend to the centrum tendineum perinei; to the levator ani, the transversus perinei superficialis, or the bulbocavernosus of the opposite side; or uncrossed to the bulbocavernosus. The anococcygeal raphe is well developed and a posterior communicating space between the ischiorectal fossæ is present. The musculus transversus perinei superficialis is poorly developed. Terminations of longitudinal bowel fibers cover the superficial surface of the

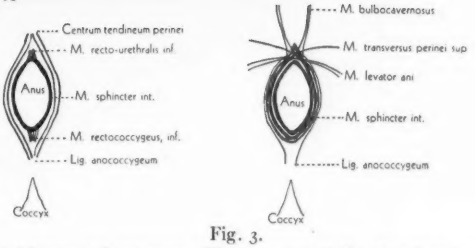

Fig. 3.

sphincter ani externus. They are especially abundant at the anterior and posterior commissures.

with three sub-branches which passed between the two superficial layers of the external sphincter (see Fig. 15 A) to send one branch to the submucous region, one to anastomose with a deeper branch of this posterior division, and one to the most superficial layer of the external anal sphincter.

2. The inferior hæmorrhoidal artery is divided into three main branches: (a) the deepest branch coursed beneath the obturator and levator ani fascia and divided into five branches to musculus levator ani; (b) the second branch extended directly medially and divided into four branches: (1) one extended anteriorly on the deepest layer of the external anal sphincter to anastomose with a branch of the posterior division of the artery of the perineum, (2) one extended posteriorly on the same muscle layer, (3) one extended to the most superficial layer of the external sphincter, and (4) one passed between the two superficial layers of the external anal sphincter to pierce the longitudinal bowel coat and help supply the most superficial layer of the external anal sphincter; (c) the posterior and largest branch divided into: (1) one twig to the deepest layer of the external sphincter; (2) one which passed between the superficial and deep fibers of the external sphincter and external to the longitudinal bowel coat to appear on the submucous layer, superficial to the internal sphincter; (3) one branch to the superficial layer of the external sphincter; (4) two branches to the most superficial layer of the external sphincter; and (5) one branch which passed superficial to both external and internal sphincter muscles to appear in the submucous layer. Branches 2 and 5 were located

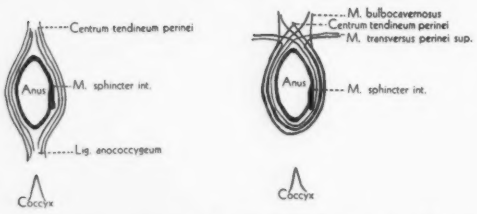

Fig. 4. Specimen 4. Male aged 19 years. Death from pancarditis. Left figure: superficial fibers of the sphincter ani externus. Some arise from the skin anterior to the anus and insert into the skin posterior to the anus. The greatest number of them, however, pass from the centrum tendineum perinei to the ligamentum anococcygeum. Right figure: the deeper fibers of the sphincter ani externus arise from the musculus transversus perinei superficialis, the musculus bulbocavernosus, and the centrum tendineum perinei. They pass around the anus posteriorly to insert in the centrum tendineum perinei, the musculus transversus perinei superficialis, and the musculus bulbocavernosus of the same or opposite side. A mass of fibrous tissue attaches this layer to the coccyx. The anococcygeal raphe is well developed and a posterior communicating space connects the ischiorectal fossæ. The musculus transversus perinei superficialis is fairly well developed. The sphincter ani internus does not form a closed circle but overlaps. Terminations of longitudinal bowel fibers pass anteriorly into the musculus transversus perinei superficialis.

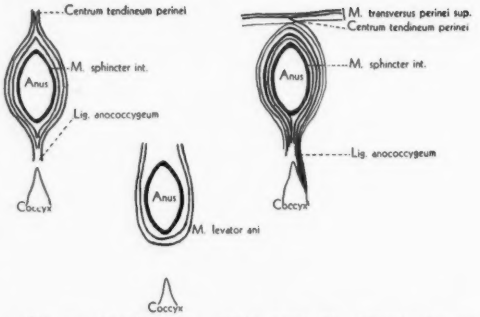

Fig. 5. Specimen 5. Male aged 66. Death due to pneumonia. Left figure: the superficial fibers of the sphincter ani externus arise from the centrum tendineum perinei and insert into the anococcygeal raphe. Right figure: the deeper fibers of the sphincter ani externus encircle the anus anteriorly to pass into the anococcygeal raphe. A very few fibers pass into the centrum tendineum perinei and some cross into the musculus transversus perinei superficialis of the opposite side. The anococcygeal raphe is well developed and the ischiorectal fossæ are connected both anteriorly and posteriorly by communicating spaces. The musculus transversus perinei superficialis fibers cross directly. Center figure: fibers of the levator ani, lying deep to those of the sphincter ani externus, encircle the anus posteriorly in particular abundance.

at approximately 5 o'clock on the posterior anal commissure. On the right side (left side of Figure 15) essentially the same arterial distribution prevailed except that another twig from the posterior division passed between the superficial layers of the external sphincter to the submucosa between the two branches 2 and 5 latterly described. Branch 2 on the right side was separated from the corresponding branch on the left side by the firm fibro-elastic band at the posterior commissure.

Branches b and c passed through the fat of the ischiorectal fossa as previously described under "B. Fascia." In this fossa many twigs, too numerous to designate with constancy, branched off to supply the fat and overlying skin. Rarely, cutaneous twigs from the artery of the perineum were noted.

D. Veins. In general the veins follow the same courses as the arteries. In the submucous layer of the anus, however, in the region of the columns of Morgagni the inferior hæmorrhoidal veins form ampullary enlargements by their anastomoses with the superior and middle hæmorrhoidal veins. These anastomoses form the submucous or internal hæmorrhoidal plexus. The veins are more numerous in the submucous layer than the corresponding arteries.

E. Nerves. The inferior hæmorrhoidal nerves accompany the arteries through the ischiorectal fossa in the fine fascial sheaths already described. Similarly the perineal nerve accompanies the artery in the superficial perineal space. Thus in reality, the external sphincter receives innervation in each of its four quadrants. The nerves enter the external sphincter at approximately a right angle to the direction of its fibers. The nerve fibers then spread out over the muscle fibers forming a plexus with numerous anastomoses called "intermuscular plexuses" by Stoehr. Unlike the ordinary nerves to skeletal muscle as described by Bardeleben (cited by Poirier and Charpy), the nerve fibers parallel the muscle fibers for but very short distances. Distances greater than two low power microscopic fields were only rarely found. Conforming with the findings of Boeke, for ordinary striated muscle, both motor and sympathetic end plates were found in the external sphincter ani. A definite plexus corresponding to the myenteric plexus of Auerbach was not iden-

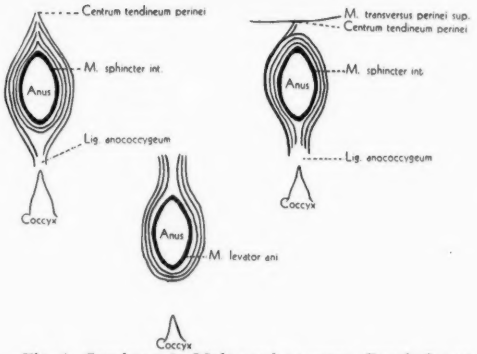

Fig. 6. Specimen 6. Male aged 45 years. Death due to carcinoma of the lung with metastases to the cranium and liver. Left figure: the superficial fibers of the sphincter ani externus are of two varieties. The central small group encircles the anus posteriorly and converges anteriorly just as does the outer group which arises from the anococcygeal raphe. Right figure: the deep layer of the sphincter ani externus also consists of two types of fibers. The largest group passes from and to the anococcygeal raphe around the anus anteriorly. A few fibers pass to the centrum tendineum perinei and to the musculus transversus perinei superficialis. Central figure: the fibers of the levator ani surrounding the anus posteriorly are particularly well marked. They tend to converge anterior to the anus where some of the fibers are attached to the centrum tendineum perinei. The anococcygeal raphe is well developed and the ischiorectal fossæ are connected by posterior and anterior communicating spaces. The musculus transversus perinei superficialis is very poorly developed.

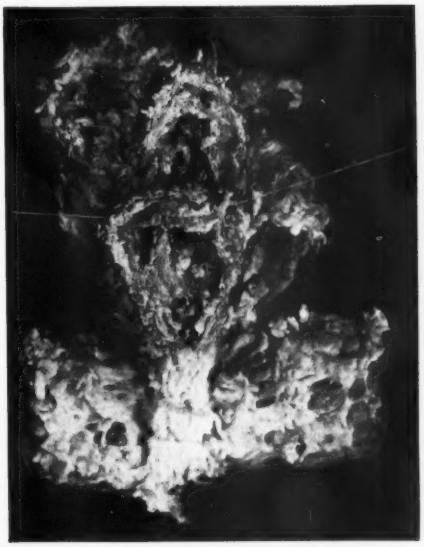

Fig. 6 A

tified although several small knobs and snarls of fibers exclusive of the nerve endings were of suggestive character. The uncertainty of the whole subject of striated muscle innervation makes a definite statement impossible at this time. The subject is thoroughly reviewed by Stoehr and Mueller. Nerve fibers were noted entering the levator ani muscle from the perineal branch of the internal pudendal nerve contrary to Braus' observations and in accord with the observations of Quain and others.

F. Lymphatics. No special study of the lymphatics was made. However, in a few of the cases examined, death was due to tuberculosis and chains of enlarged glands in the pelvis were noted to conform with the classical descriptions of Gerota, and Poirier and Cuneo, quoted by Lynch and Felsen, Gant, and Davis.

DEDUCTIONS

Why is the internal opening of the majority of anal fistulæ constantly within the anocutaneous junction at points corresponding to 5 and 7 on the clock, considering the posterior median line as 6 o'clock?

Excluding the epithelized fistulæ due to congenital anomalies resulting from the indentation of the proctodeum (Bartholdy), pulsion diverticula arising through propulsion of a crypt of Morgagni by a foreign body (Meisel) associated with ulceration and traversing both sphincter muscles (Chiari), or from cystic degeneration of a Sinus Hermanni (Tavel) or a cyst of Physick, although the cysts of Physick have been described as diverticula resulting from the rupture of a submucous hæmorrhage into the bowel, and excluding also fistula due to stricture of the rectum (Salmon), fissure (Mummery), osteomyelitis of the coccyx, carcinoma, syphilis, gonorrhœa, typhoid, bacillary or amœbic dysentery, foreign bodies, injection of hæmorrhoids or other operative or non-operative rectal injuries, the *common* or remaining type of fistula *in ano* has been conceived by Hippocrates, Arderne, Bryant, Cruveilhier, Aschoff, Davis, Esmarch, Gant, Hirschman, Kaufman, Mummery, Quénu and Hartman, Rotter, and others as following periproctitis or abscess. In spite of the settlement of the controversy regarding

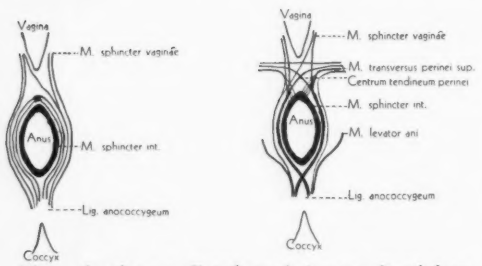

Fig. 7. Specimen 7. Female aged 38 years. Death from meningitis following a mastoid operation. Left figure: the superficial fibers of the sphincter ani externus arise from the anococcygeal raphe and either encircle the anus anteriorly, or extend anteriorly into the musculus sphincter vaginæ of the same or opposite side. The area between the vagina and anus is occupied largely by scar tissue. Right figure: the deeper fibers arise from the deep surface of the anococcygeal raphe and extend either around to the musculus transversus perinei superficialis on the same or opposite side, or to the musculus sphincter vaginæ on the same side. These fibers cross posteriorly on the deep surface of the anococcygeal raphe. Fibers also pass from the anococcygeal raphe to the levator ani on the same side. Fibers of the musculus levator ani, not shown in the sketch, encircle the anus posteriorly. The anococcygeal raphe is well developed and the ischiorectal fossæ are connected posteriorly by a communicating space. The sphincter ani internus is 3 millimeters thick and unusually well pronounced. The musculus transversus perinei superficialis is fairly well developed and possesses a few fibers which cross the midline directly; but most of its fibers are interrupted in the region of the centrum tendineum perinei by scar tissue. Many terminations of the longitudinal bowel coat pass into the musculus transversus perinei superficialis anteriorly. Terminations of longitudinal bowel fibers are prominent around the whole circumference of the anal outlet except in the posterolateral quadrants.

the part played by tuberculosis in the etiology of anal fistula, stimulated by Melchior and concluded by Gabriel, one is surprised to note that Sigmund in the new "Henke and Lubarsch" considers the work of Melchior as conclusive, although Frey, in 1913, showed that Melchior's conclusions of 1910 were based on the findings of tuberculosis in 5 out of 10 suspected cases. Gabriel's figure of 20 per cent based on the careful examination histologically and by animal inoculation of 75 successive cases, is a bit higher than generally conceded clinically by proctologists, but is probably more accurate.

Given, then, a peri-anal abscess, the pathogenesis of which will be considered later, why is the internal opening constantly located as previously described? A short study of Figure 15 discloses that the points of entrance into the submucosal space of vessels from the ischiorectal fossæ and anal region corresponds with 5 and 7 on the clock. The pus has only to follow the thin vascular sheaths and a single internal opening on each side and numerous external openings will likely result. It would seem unusual for pus to enter the external perineal space from the ischiorectal region, and consequently its entrance into the anal canal in its anterior two-thirds is prevented. Exceptionally, however, superficial communications do exist between the branches of inferior hæmorrhoidalis artery and the artery of the perineum and then the unusual anterior openings are explained. The previously described phenomena observed by Edwards and Tuttle with regard to the openings of fistulæ are also explained by these anatomical conditions. The horseshoe fistula and the rarity of anterior communications is also clarified by a comparison of the frequency of the anterior and posterior spaces connecting the ischiorectal fossæ.

How does the peri-anal abscess arise?

It is not difficult to conceive of the method of origin of an abscess in one of the peri-anal sebaceous glands or glands of Gay; but an abscess in order to bear an etiological relation to fistulæ will most likely be of enterogenous origin. How the infecting organisms get into the peri-anal tissues, has been a subject of much dispute. Bryant, in 1861, disagreed with the popular conception that an abscess is always preceded by an ulcer. If this were true, every case of abscess would be associated with a fistula. However, of 236 cases of abscess, fistula, or both, 43 cases began and ended as abscess without developing a fistula. Foreign bodies have been a popular etiological factor in abscess formation. Esmarch ascribed the etiology of some cases to suppuration of a hæmorrhoid. In addition to the predisposing causes of rowing and riding (Hippocrates), local trauma and exposure to cold, Quénu and Hartman believed that lymphangitis of rectal origin was the most important factor in the development of abscess in spite of the absence of inguinal adenopathy. The adenopathy is prevented by thrombosis in the lymphatics preventing further progress of the infection. If the presence of lymph glands in the ischiorectal fossa as shown in an illustration by

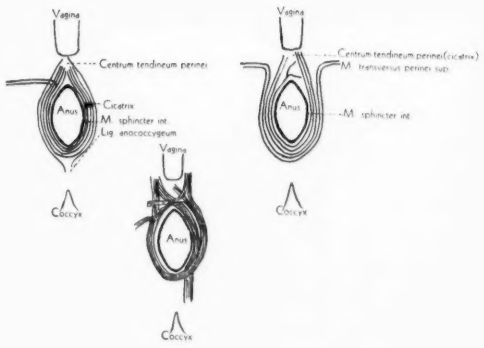

Fig. 8. Specimen 8. Female aged 72 years. Death from bronchopneumonia. Left figure: superficial fibers of the sphincter ani externus. Two fibers arising from the centrum tendineum perinei extend posteriorly toward the anococcygeal raphe. The remaining fibers of this layer arise abruptly on the right side in the anterior quadrant and either pass directly forward to the centrum tendineum perinei or encircle the anus posteriorly to insert into the centrum tendineum perinei and the musculus transversus perinei superficialis of the left side. This layer is attached to the deepest layer on the right side by a short fibrous band. Right figure: the middle layer of fibers of the sphincter ani externus, 1 centimeter wide and 2 millimeters thick, encircles the anus posteriorly and inserts uncrossed into the musculus transversus perinei superficialis and an area of scar tissue anterior to the anus. Some fibers from the left side pass across the scarred area to be attached by fibrous tissue to the fibers of the right side. They are not continuous. Center figure: the deepest fibers of the sphincter ani externus arise on the right side from the area of scar tissue anterior to the anus and from the area posterolateral to the vagina. They encircle the anus posteriorly and insert into the deep surface of the left musculus transversus perinei superficialis and the left posterolateral vagina area. Some fibers return to the right posterolateral vagina area and, passing deep to the fibers above described, proceed posteriorly toward the coccyx on the right side. Fibers from the middle layer, lying superficial to the deep fibers above described, pass from the left side to the right posterolateral vagina area. The sphincter ani externus in this specimen has only an insignificant attachment to the coccyx and the ischiorectal fossæ communicate through a large posterior space. The sphincter ani internus is 1 millimeter thick and 3 millimeters wide. It lies deep in the anal pit and is not a pronounced ring. The musculus transversus perinei superficialis is fairly well represented.

(Right and left as employed in the text of the foregoing description refer to the sketch. The directions are reversed in the actual specimen.)

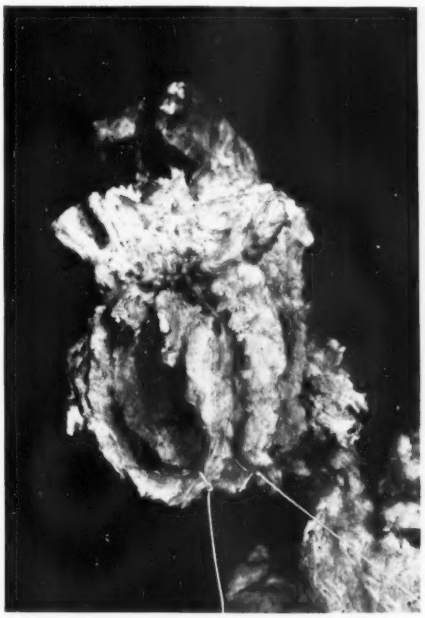

Fig. 8 A

Fig. 8 A. Specimen 8. Showing the layers of muscle fibers encircling the anus posteriorly, the wide space between the coccyx and external sphincter through which the ischiorectal fossæ communicate, and the area of scar tissue between the anus and vagina.

Miles, could be substantiated, the lymphatic path in cases of ischiorectal abscess would be obvious. Unfortunately, anatomical works and the results of this study fail to substantiate the finding. However, organisms, once having gained the submucosal space, whether through ulceration, injury, fæcal stagnation, or pure penetration, should find no difficulty in reaching the poorly nourished fatty areas in the anal triangle by merely following the perivascular spaces. Once having found a locus minoris resistentiæ, they can form an abscess which may or may not be associated with a fistula.

What anatomical information can one obtain by anal palpation?

With the index finger in the anus and the thumb outside of the anus, one can feel the internal sphincter as a distinct band in most cases. There is little doubt that many erroneous conceptions of the anatomy of the external sphincter are due to confusion between the two. In many cases the so called Pecten band incised for the cure of fissure is none other than the internal sphincter.

The fat filled ischiorectal fossa interposes an additional barrier to palpation laterally; and, posteriorly, the palpating fingers grasp not

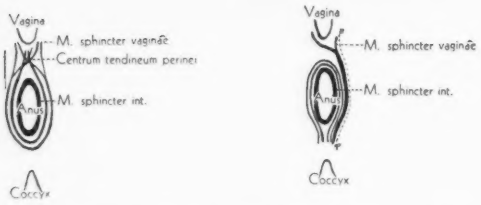

Fig. 9. Specimen 9. Female aged 8 years. Death from miliary tuberculosis and tuberculous meningitis. Left figure: the superficial fibers of the spincter ani externus encircle the anus posteriorly on their way to and from the centrum tendineum perinei and the areas posterolateral to the vagina. The latter fibers may cross anterior to the anus. Right figure: the deep fibers of the sphincter ani externus spread out over the fibers of the levator ani muscles and continue to the lateral aspects of the coccyx by fibrous extensions (anococcygeal raphe). A small number of fibers encircle the anus anteriorly and extend posteriorly into this anococcygeal raphe. About three times as many fibers arise from the anococcygeal raphe and extend anteriorly to insert into the posterolateral vagina area of the same or opposite side. The levator ani fibers surround the anus posteriorly and continue anteriorly as shown by the broken line *P—P*. The fibers converge a bit toward the centrum tendineum perinei but there is no striated muscle notable between the rectum and vagina. The anococcygeal raphe is poorly developed and superimposes the levator ani muscles such that the usual type of posterior communication does not exist between the ischiorectal fossæ. However, since the fibers of the superficial layer of the external sphincter are the most numerous and extend quite some distance below the level of the coccyx, the communication is superficial to the anococcygeal raphe. The sphincter ani internus is 1 millimeter thick and 4 millimeters broad. The muscle extends to the level of the anocutaneous junction. The muscle area posterolateral to the vagina is not separable into components. Terminations of longitudinal bowel fibers pass into the levator ani and a layer 1 millimeter thick separates the anal sphincters anterolaterally. Even more notable are these fibers at the anterior and posterior commissures where they pass into the centrum tendineum perinei and the anococcygeal raphe respectively. The posterolateral quadrants of the anal outlet are practically devoid of longitudinal fibers.

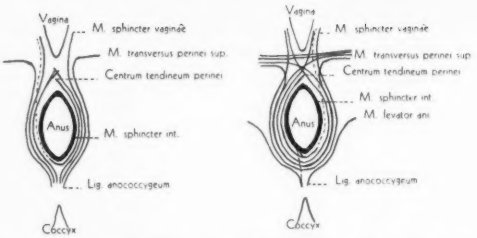

Fig. 10. Specimen 10. Nulliparaous female aged 27 years. Death due to bronchiectasis and pneumonia. Left figure: the superficial layer of the sphincter ani externus arises in the anococcygeal raphe and passes forward to the musculus sphincter vaginæ and musculus transversus perinei superficialis of the same side, or to the centrum tendineum perinei. Fibers also arise at the centrum tendineum perinei and after encircling the anus posteriorly, pass forward deep to the whole sphincter ani externus to continue with the fibers of the levator ani. Right figure: the deep layer of the sphincter ani externus consists of fibers which are the mirror image of the last described superficial fibers. Both the superficial and deep sets of these fibers receive longitudinal bowel fibers as they encircle the anus posteriorly. In addition fibers of the deep layer encircle the anus posteriorly in considerable numbers on their way to and from the musculus transversus perinei superficialis and musculus sphincter vaginæ. The anococcygeal raphe is well developed and the ischiorectal fossæ communicate by a posterior space deep to it. The sphincter ani internus is 1 millimeter thick and 2 centimeters wide. The musculus transversus perinei superficialis is well developed and possesses fibers which pass directly across the midline. Terminations of longitudinal bowel fibers are numerous anteriorly and posteriorly at the anal outlet.

only the anococcygeal raphe and the underlying fat filled posterior communicating space, but also the combined levator ani, and rectococcygeus muscles as they arise from the coccyx. The external anal sphincter does not arise from the tip of the coccyx but from the sides, or, its attachment to the coccyx may be almost negligible, as previously described (see Fig. 13). The accurate determination of the anatomy of the external anal sphincter clinically by palpation is, therefore, a doubtful matter. A survey of the sketches 1 to 13, inclusive, discloses that the external anal sphincter possesses no fixed anatomy, that its layers do not encircle the anus as closed rings, nor do they consist purely of anteroposteriorly extending layers. The muscle usually consists of a variety of fibers which either encircle the anus anteriorly or posteriorly, or extend anteroposteriorly. The central tendon of the perineum serves as a fixed point, protecting the function of the anal sphincter by isolating it from perineal tears of childbirth and incisions through the perineum for prostatic and seminal vesicle operations. Von Frankl-Hochwart and Froehlich determined that the external anal sphincter plays only a one-third to one-half part in the entire closing tonus of the anus. Matti estimated the importance of the external sphincter as 60 to 65 per cent, since, when its influence is removed, the internal sphincter acts peristaltically and maintains only a transitory resistance to a dilating force. By palpation of the internal sphincter, one may deduce facts regarding the external sphincter which may not be directly palpable.

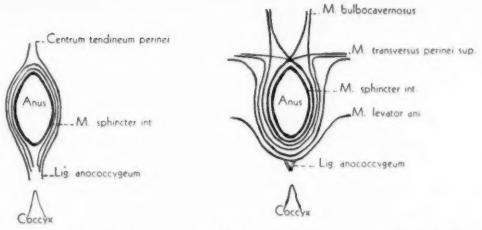

Fig. 11. Specimen 11. Male aged 30 years. Death due to pulmonary tuberculosis. Left figure: superficial layer of the sphincter ani externus. Lateral fibers comparatively few in number arise from the skin, underlying centrum tendineum perinei, and musculus bulbocavernosus and extend posteriorly into the anococcygeal raphe. The greater number of superficial fibers surround the anus anteriorly and pass posteriorly into the anococcygeal raphe. Right figure: the deep fibers of the sphincter ani externus encircle the anus posteriorly and pass into the musculus levator ani, the musculus transversus perinei superficialis of the same or opposite side, the musculus bulbocavernosus of the same or opposite side, or the centrum tendineum perinei. The definition between superficial and deep layers is very difficult; many fibers pass from one layer to the other. The anococcygeal raphe is only fairly well developed, but the posterior space connecting the ischiorectal fossæ is well pronounced. The sphincter ani internus is 0.5 millimeter thick and firmly bound to the sphincter ani externus through longitudinal bowel fibers. Terminations of longitudinal bowel fibers are especially numerous at the anterior and posterior commissures.

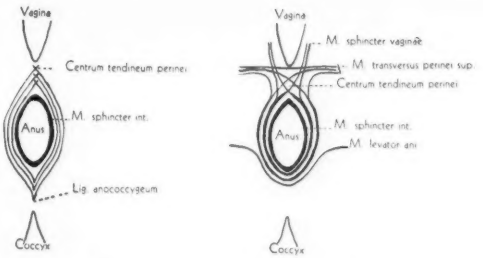

Fig. 12. Specimen 12. Female aged 42 years. Death due to pulmonary gangrene following a cholecystectomy. Left figure: the superficial layer of the sphincter ani externus consists of only a few fibers extending from the skin and underlying centrum tendineum perinei around the anus to the skin and underlying anococcygeal raphe. Right figure: the fibers of the deep layer of the sphincter ani externus encircle the anus posteriorly and pass to the levator ani of the opposite side, the musculus transversus perinei superficialis of the same or opposite side, or the musculus sphincter vaginæ of the same or opposite side. The anococcygeal raphe is poorly developed. It contains only a few muscle fibers. The ischiorectal fossæ are connected by a posterior communicating space. The sphincter ani internus is 0.7 millimeter thick and 1 centimeter wide. The musculus transversus perinei superficialis is fairly well developed. It possesses fibers which pass directly across the midline as well as some which are lost in the scar tissue anterior to the anus.

Does the anatomy of the sphincter muscles account for the possibilities of incontinence following dilatation or cutting of the sphincters?

In dilatation of the sphincter, introduced by Recamier (Esmarch, 20), excessive vigor, rapidity, and light anæsthesia are undoubtedly contributing factors to injury. Textbooks caution the operator not to dilate anteroposteriorly, but from side to side. Experience has no doubt sponsored this precaution and one may readily conceive the effect of an injury to the central tendon of the perineum from behind, knowing the effect of an anterior tear. Further, one may conceive how even side to side dilatation in Specimens 2, 8, and 12 might affect continence, especially if the internal sphincter be injured during the procedure, as is likely in cases in which the internal sphincter fails to form a complete circle (Specimen 4). Partial and permanent sphincter injury following dilatation has been observed by Melchior, Clairmont, and others.

That incision of the external sphincter is liable to be followed by interference with continence, is a fact quite generally conceded. In spite of the enthusiasm of Gant for the procedure, he admits that 1 per cent of 1,000 private cases and less than 5 per cent of 1,000 clinic cases of fistula developed postoperative fæcal incontinence. Esmarch felt that the poor results following cutting of the sphincter were not due to injury of the muscle itself but to cutting of motor nerves through oblique or numerous incisions, since the motor nerves enter the muscle in several places. To substantiate this conception, he referred to cases in which continence returned a year after the operation when the nerve had had time to regenerate. The anatomical basis for this theory is correct, since this study has shown that unlike the ordinary nerves to skeletal muscle the nerve fibers parallel the muscle fibers but very short distances. However, the conclusions are erroneous, since physiological work previously described demonstrated the existence of a tonus center within the muscle, since it contracts as a whole when stimulated, and does not degenerate when its nerves are cut. The loss of a part of its motor nerve

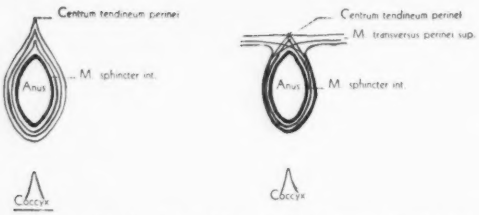

Fig. 13. Specimen 13. Male aged 41 years. Death due to pulmonary tuberculosis. Left figure: the superficial fibers of the sphincter ani externus form a heavy layer 2 to 3 millimeters thick and 1 centimeter wide surrounding the anus posteriorly and inserting into the centrum tendineum perinei and overlying skin at the base of the urethral bulb. Right figure: the deep fibers of the sphincter ani externus also encircle the anus posteriorly and pass forward to the musculus transversus perinei superficialis of the same or opposite side, or to the centrum tendineum perinei. There is essentially no anococcygeal raphe, only a few strands of fibrous tissue forming a band 2 millimeters wide unite the external sphincter with the coccyx. The posterior communicating space between the ischiorectal fossæ is, therefore, particularly well marked. The sphincter ani internus is 1 millimeter thick and 1 centimeter wide. The musculus transversus perinei superficialis is fairly well developed and possesses fibers which cross the midline directly. Terminations of the longitudinal bowel fibers are numerous anteriorly and posteriorly at the anal outlet.

supply would, therefore, not greatly interfere with continence. A survey of Figures 1 to 13, inclusive, demonstrates that continence is affected by cutting of the external sphincter by a springing apart of the cut muscle ends. This complication is in part prevented by the fixation of the sphincter muscles to the skin and mucous membrane by the fibro-elastic terminations of the longitudinal bowel coat as well as by the fibers of the external sphincter which encircle the anus posteriorly and end in the levator ani muscles, as in Specimens 10, 11, and 12. One can well appreciate the success of surgeons who preferred to save the cutting of the sphincter for a second stage when it had become firmly fixed to surrounding structures by fibrous tissue in cases in which the external sphincter had been essentially deprived of its fixation by burrowing fistulæ. This condition would be especially true of fistulæ necessitating the cutting of the sphincter in more than one place, where the likelihood of an isolated circular segment becoming realigned would be very remote. The latter clinical observation is in itself proof against the bilaterality, i.e., solely anteroposterior direction of the fibers, of the external

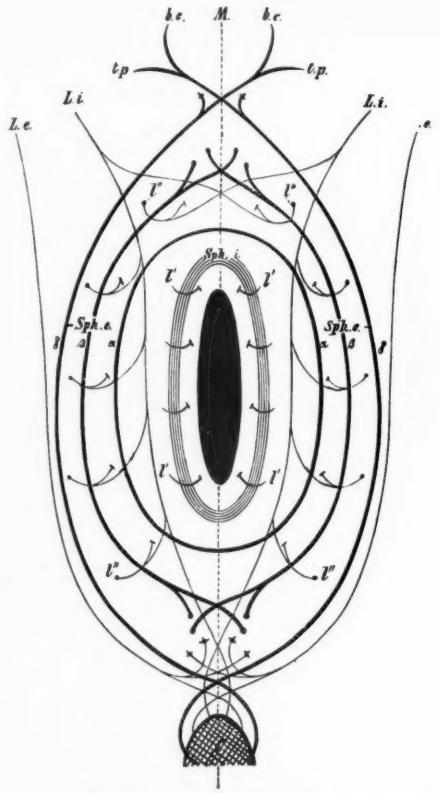

Fig. 14. Schematic presentation of the course of the fibers of the anal musculature. *M*, Median line; *C*, coccyx; *l*, prolongation of the longitudinal fibers of the musculature of the rectum; *l'*, muscular bundle which passes through the internal sphincter; *l''*, muscular bundle which passes through the external sphincter which surround these groups of fibers below; *sph.i.*, internal sphincter; *sph.e.*, external sphincter; *α*, closed circular layer of muscle; *β*, skin; *γ*, coccygeal layer with partial irradiation into the bulbocavernosus muscle, *b.c.*, and into the superficial transverse perineal muscle, *t.p.*; *L.i.*, inner, *L.e.*, outer-layer of the levator ani. The superficial insertions into the skin are indicated by points, the deeper ones into the median raphe are indicated by crosses. From C. Roux, Arch. f. mikr. Anat, 1881, xix, 732.

sphincter muscle. Various methods such as immediate suture, and the operations of Pennington and Moszkowicz, have been suggested to overcome this complication of fistula surgery but the therapy of fistula is too extensive a subject to discuss at this time.

Another muscle of considerable importance in the maintenance of continence is the levator

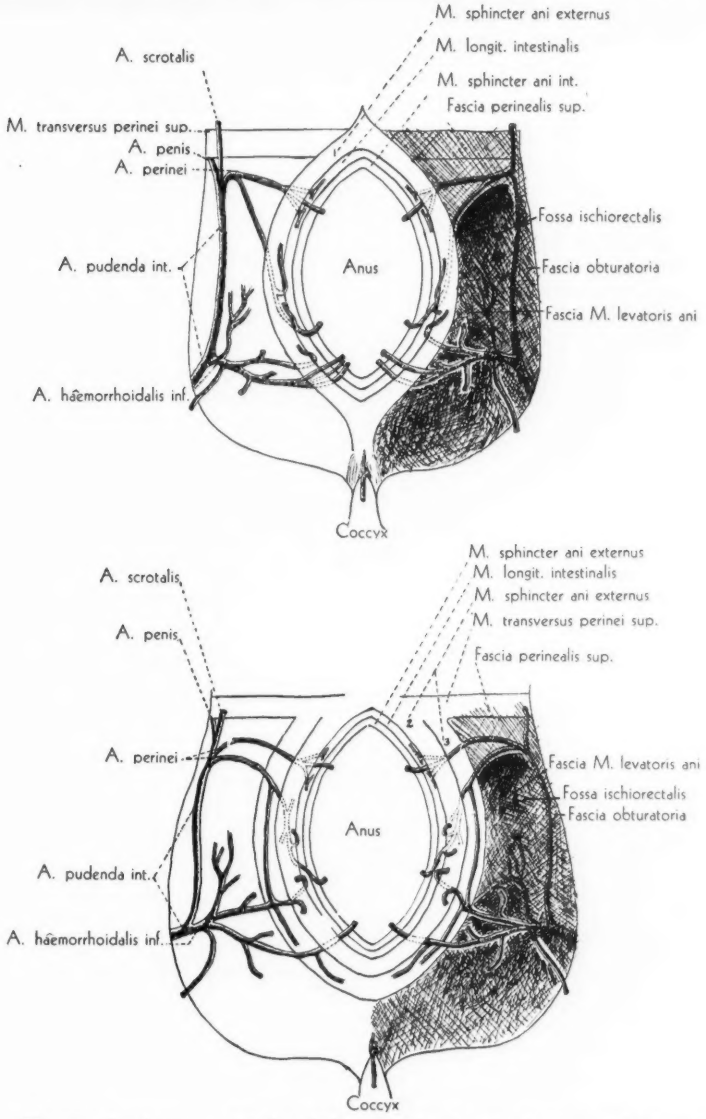

Fig. 15. Specimen 4. Arteries of the anal triangle. A, above, superficial; and B, deep views. The numbers *1*, *2*, and *3* designate the relative depths of the fibers of the sphincter ani externus from *1*, superficial, to *3*, deep. Note that the anterior two-thirds of this muscle and the anal outlet are supplied by the arteria perinei and that the inferior hæmorrhoidal vessels passing to the submucous layer of the anus do so at points corresponding to approximately 5 and 7 on the clock. Note also that the inferior hæmorrhoidal vessels pierce the ischiorectal fossa with the exception of one division which lies under the obturator and levator ani fasciæ; whereas, the arteria perinei passes from the arteria pudenda inferior to the external sphincter and anus through the superficial perineal space almost completely isolated from the ischiorectal fossa.

ani muscle. Treitz described its effect as an increase in the anterior angulation of the bowel at the recto-anal junction, thus constricting the bowel transversely.

Does the anatomy of the external sphincter account for the etiology of anal fissure as advocated by Mummery?

Anal fissure, first accurately described by Boyer, in 1818, has been described as a superficial ulcer, occurring in the vicinity of the posterior commissure in men in 90 per cent of the cases and in women in 60 per cent of the cases (Hirschman). Quénu and Hartman describe an inflamed nerve filet lying deep to the ulcer in certain cases. The etiological basis for simple or single ulcer has been ascribed by Gant to trauma initiated by: constipation, evacuation of hardened fæces, tearing down of a crypt of Morgagni (Ball), careless digital or instrumental examination, passage of foreign bodies swallowed, birth injuries, divulsion of the sphincter, pessaries, careless introduction of enema tubes and instruments, prostatic massage, and pederasty. Baker Brown, in 1864, who attributed anal fissure to onanism in women, demonstrated that irritation of the clitoris produced fairly strong contractions of the anal sphincter with the patient under chloroform anæsthesia. Quénu and Hartman believed that hæmorrhoids played an important etiologic rôle in fissure.

The posterior location of fissure described by DaCosta, Esmarch, Gant, Hirschman, Mummery, Rotter, and others has been attributed to "the fact that on account of the concavity of the sacrum the curvature of the rectal and anal canal is such that the greatest force during the expulsion of the stool is toward the posterior commissure; also, it must be remembered, that some of the fibers of the sphincter ani muscle parallel each other to the coccyx, and this is the direction of the anal line of cleavage" (Hirschman). Mummery explains the posterior location as follows: "It has always seemed to me that the explanation is to be found in the structure of the external sphincter muscle itself. This muscle is not, as has often been supposed, a circular muscle, but consists of a band of muscle fibers arising from the coccyx, which passes forward and splits to surround the anus; in front it is partly inserted into the perineal point and partly continuous with the opposite side. The external sphincter muscle is, therefore, not really a circular muscle, but consists of two lateral halves. In front these halves are almost continuous, but posteriorly for the most part placed parallel with each other. From the arrangement of the fibers of the external sphincter, it will be seen that the mucous membrane and skin of the anal canal are best supported at the sides, and least supported at the posterior commissure, but the next weakest place being the anterior commissure. In women, owing to the presence of the vagina, the anterior commissure receives less support than is the case in men. . . . If, therefore, the anus is stretched unduly, the point at which it gives way is the posterior commissure, and the next weakest place is the anterior commissure, since only some of the fibers are circular here. A further proof that this is the true explanation of the formation of a fissure is afforded by the fact that when the mucous membrane of the anal canal gives way during the process of stretching the sphincter—an accident that may easily happen if the stretching be done too quickly—it always does so at the posterior commissure, showing that this is the weakest point of the muscle. If the sphincter ani is forcibly stretched in the cadaver, it will be found that tearing always occurs posteriorly."

A review of the Figures 1 to 13, inclusive, will show that the argument of Mummery is based on a wrong premise, namely, the constancy of the anatomy of the external anal sphincter. The ancient and mediæval conception of the fundamental pathology as "anal cramp" or spasm of the internal sphincter, whether primary or secondary, has more than a grain of reason to it as demonstrated by the successful results obtained by mere incision of this muscle, though it be mistaken for the so called pecten of Stroud by some surgeons. The relationship of the sex organs to sphincter spasm demonstrated by Brown probably plays a greater rôle than has been generally conceded, since the disease is most common during adult life, although found in children addicted to pederasty. The firm fixation of the posterior commissure and to a

lesser extent the anterior by the fibro-elastic terminations of the longitudinal bowel coat plus the lateral free mobility of the mucous coat probably play a greater rôle in the etiology of anal fissure than does the contour of the external anal sphincter.

The late Dr. L. A. Greensfelder, with whom I had the good fortune to be associated, felt quite convinced that he could trace a definite relationship between irritating breakfast foods, such as bran, and anal fissure.

SUMMARY

The anatomy and physiology of the anal sphincters are reviewed historically as a basis for this study to explain the pathogenesis of anal fistula, abscess, fissure, and postoperative incontinence. The constant location of the internal opening of anal fistula at 5 or 7 o'clock is explicable by the arrangement of the vessels in the anal triangle, the infection following the perivascular spaces. The anatomy of the external sphincter alone does not explain the origin of fissure, but the great accumulation of fibro-elastic terminations of longitudinal bowel fibers fixing the anterior and posterior commissures is probably a factor. The anatomy of the external sphincter may account for incontinence following stretching or incision of the sphincter, since, when its influence is removed, the efficiency of the internal sphincter becomes reduced because the mechanical stimulus necessary for the maintenance of resistance to a dilating force is lacking. The external sphincter consists neither entirely of fibers encircling the anus nor of fibers extending anteroposteriorly, but is a mixture of the latter type with fibers encircling the anus either anteriorly or posteriorly, in varying proportions.

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USE OF HYPERTONIC SODIUM CHLORIDE SOLUTIONS TO STIMULATE PERISTALSIS

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IN 1924, Hughson and Scarff noted the effect of intravenous sodium chloride on peristalsis. They used cats as experimental animals. As soon as a 30 per cent solution of sodium was injected intravenously, the intestine showed marked peristaltic activity. This activity persisted in some instances as long as 55 minutes. They noted the same effect with much less intensity when physiologic salt solution was used. These authors state that the use of hypertonic sodium chloride solutions injected intravenously furnish a distinctly reliable agent for promoting peristalsis in intestinal loops, which for some reason have lost their power of motor activity. In a study of the effect of several salts upon intestinal movements, Dreyer and Tsung noted that hypertonic solutions of sodium chloride caused an increase in intestinal movements. No effect was produced by the use of isotonic sodium chloride. Carlson and Wangensteen show tracings of increased activity of the small bowel after injecting intravenously 15 cubic centimeters of 20 per cent solution of sodium chloride, but do not discuss the observation. Ross has shown both experimentally and clinically that hypertonic sodium chloride solution will produce active peristalsis. He recommends its clinical use.

In a recent series of experiments on dogs, we have compared the activity of the small intestine after giving intravenously physiologic sodium chloride solution, hypertonic sodium chloride solution, hypertonic glucose solution, and 4 per cent sodium bicarbonate solution. Our experiments were all conducted on the upper jejunum. A Thiry-Vella loop was made about 18 inches long beginning about 6 inches below the ligament of Treitz.

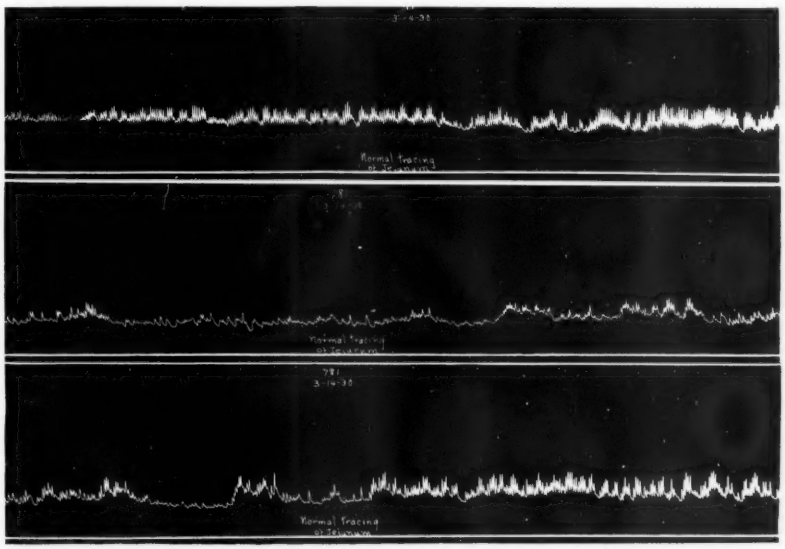

Fig. 1. Variations in the normal tracing of the jejunum. A, B, and C cover a period of one and one-half hours.

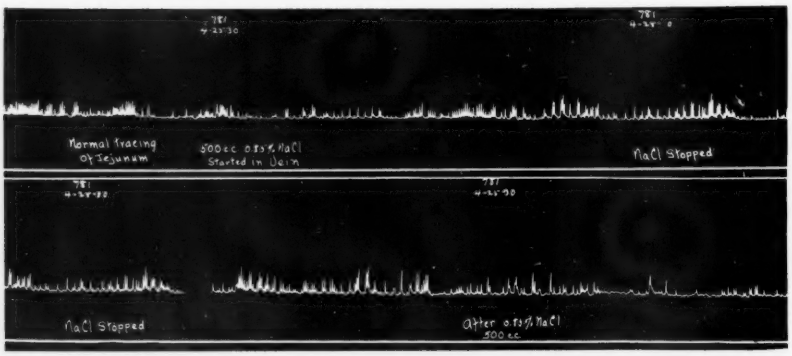

Fig. 2. Tracing of jejunum before and after intravenous administration of .85 per cent sodium chloride solution. No change is noted either in tone, rhythm, or peristalsis.

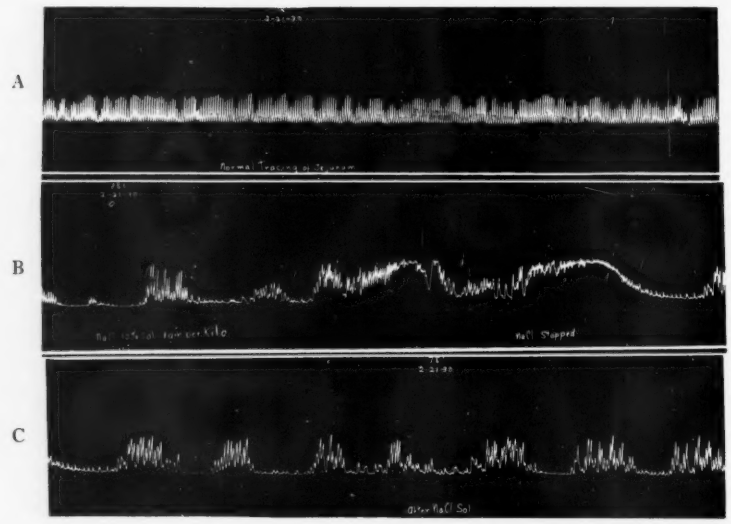

Fig. 3. Tracing of jejunum before and after intravenous injection of a 10 per cent sodium chloride solution, 1 gram per kilogram of body weight. A, Normal tracing. B, Injection of salt solution, showing increase in tone and peristalsis. C, Forty minutes after injection of hypertonic salt solution.

After complete healing had resulted following operation, tracings were begun. All tracings were made on kymograph records, a rubber bulb filled with air being used in the gut. In most cases the air pressure within the bulb and tube was kept quite uniform by measuring with a mercury column and marking on the kymograph drum before tracings were begun. Dogs were fasted for 36 hours before the experiments so that the upper intestinal tract would be relatively empty.

EXPERIMENTAL RESULTS

After the intravenous administration of physiologic sodium chloride solution no change in the gut contractions was noted (Fig. 2). If hypertonic sodium chloride solution in 5 to 10 per cent strength was given,

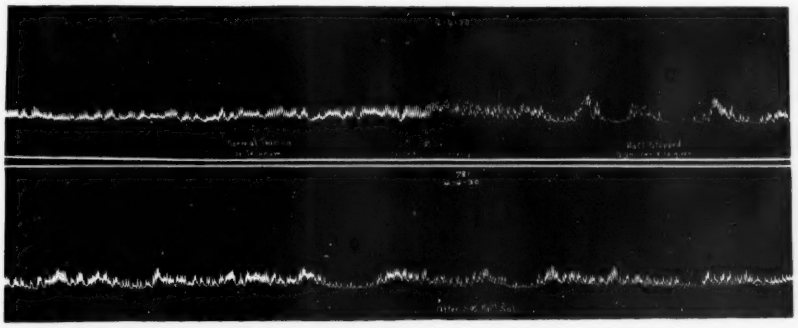

Fig. 4. Tracing of jejunum before and after intravenous administration of 5 per cent sodium chloride solution, ½ gram per kilogram of body weight. Slight increase in tone and peristalsis is noted.

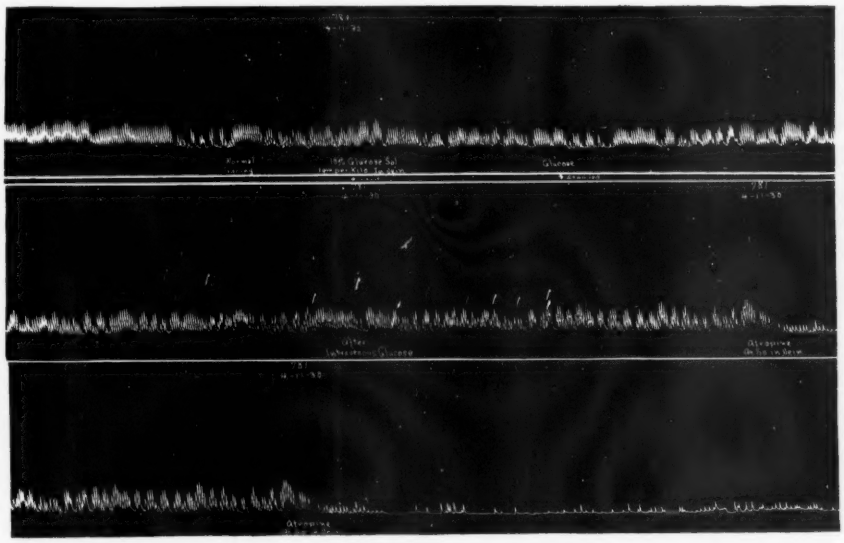

Fig. 5. Tracing of jejunum before and after intravenous injection of 10 per cent glucose solution, 1 gram per kilogram of body weight. No change is noted after glucose injection. C, Atropine, grain 1/50, intravenously injected, causes almost immediate suspension of intestinal movement.

there always resulted an increase in the activity of the gut by raising the tone and starting active peristalsis (Figs. 3 and 4). Hypertonic glucose solution had no appreciable effect upon the gut movements (Fig. 5). A 4 per cent solution of sodium bicarbonate caused an almost immediate onset of active peristaltic waves that continued active for 30 to 45 minutes (Fig. 6). Administration of an ether anæsthetic during a jejunal tracing immediately stopped the rhythmic contractions. During anæsthesia hypertonic sodium chloride solutions did not stimulate peristalsis. After the ether was removed the contractions were resumed. Atropine likewise immediately stopped contractions.

SUMMARY AND CONCLUSIONS

Our experiments confirm the observations of others that hypertonic sodium chloride

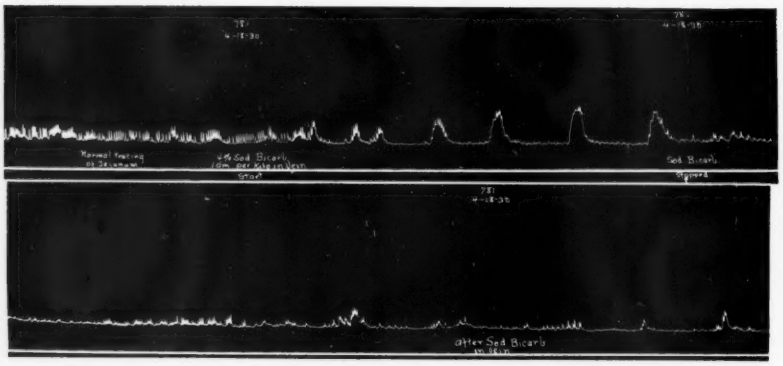

Fig. 6. Tracing of jejunum before and after intravenous administration of a 4 per cent sodium bicarbonate solution, 1 gram per kilogram of body weight An immediate development of marked peristalsis is noted after injection of the solution. This marked change lasted from 25 to 45 minutes following injection.

solutions stimulate peristalsis. We did not find, as did Hughson and Scarff, that physiologic sodium chloride solution caused a change in the activity of the intestine. The introduction of hypertonic sodium chloride solution into the bowel caused violent peristalsis in one of our animals with vomiting and defæcation. Some of our animals had bowel movements soon after the injection of hypertonic sodium chloride solution. Some appeared to have discomfort as if the increased bowel activity caused colic.

From the clinical and experimental observations it seems probable that sodium chloride introduced into the body serves to (a) replace the chlorides lost in certain diseases such as intestinal obstruction; (b) probably is an active factor in water distribution in the body; (c) stimulates peristalsis and (d), by increasing the tone of the bowel, diminishes postoperative distention and ileus with its resultant anti-peristalsis and vomiting.

A study of the action of physiologic sodium chloride solution, hypertonic sodium chloride solution, hypertonic glucose solution and hypertonic sodium bicarbonate solution on peristalsis of the jejunum was made and the following conclusions reached; The stimulating effect of hypertonic sodium chloride solution upon peristalsis is further evidence of its value in the treatment of paralytic ileus and following operation for the relief of intestinal obstruction.

2. Further observation is necessary to determine the clinical value, if any, of sodium bicarbonate as a peristaltic stimulant.

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HYPERTROPHY OF THE PYLORIC MUSCLE IN ADULTS

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FIVE cases of a rather rare condition have come to my attention recently. Although the condition is but sparsely covered by the medical literature, is frequently undiagnosed or is erroneously diagnosed, ofttimes is not discovered until autopsy, and is of unknown and disputed etiology, yet it is responsible for severe and protracted symptoms, and sometimes even for death. The condition is variously designated by the few writers who have published reports of cases as chronic pyloric hypertrophic stenosis, chronic hypertrophy of the pylorus, congenital hypertrophic stenosis in adults.

Since the condition was first discussed by Maier in 1885, writers have disagreed regarding its etiology. Some contend that it is a continuation of the well known congenital stenosis of infancy (Fig. 1), which may have increased with growth, thus delaying the development of noteworthy symptoms. Some writers suggest that it may have been present in a latent form, active symptoms being produced perhaps by some infection, severe nervous strain, or other condition which has had a trigger effect. Others have adduced evidence suggesting an endocrine origin, Pirie believing that hyperadrenalism is the stimulus which brings on hypertrophy and stenosis. He contends, according to Chaney, that the secretory stimulation of the pancreas is inhibited by excessive adrenalism and that the lack in pancreatic secretion delays the neutralization of the acid chyme from the stomach, causing the pylorus to remain closed for an abnormal length of time, this closure in turn producing gastric retention and hyperacidity followed by pyloric hypertrophy. Chaney cites a case which was partially relieved by the administration of thyroid extract.

It is my own conception that chronic hypertrophic pyloric stenosis may possibly be the result of long standing spasticity of the pyloric muscle. In our cases, nervousness was a prominent symptom, and this alone is capable of producing a spasticity of the pylorus which if long continued might in turn cause hypertrophy of the spastic tissue. Archer, too, believes that spasm due to reflex irritation undoubtedly may be an etiological factor, and if long continued will lead to hypertrophy.

While undoubtedly the etiology of this disease is a fascinating theme for discussion and study, it is obvious that there is in these patients a definite pathological condition which is capable of causing severe symptoms, even though it may be present for some years before becoming serious, and the important matter, therefore, is its recognition and treatment. It is our earnest plea that clinicians as well as roentgenologists consider the possibility of the presence of hypertrophy of the pyloric muscle in all cases which present obscure epigastric symptoms. The fact that in most of the reported cases the condition has been recognized only at autopsy suggests that it is not so rare as the paucity of references in the literature would seem to imply. This fact is an indication, also, of the need for improved methods of diagnosis.

REPORT OF CASES

The first of the cases we have to present illustrates the type of pyloric hypertrophy which is either symptomless or in which the symptoms are overshadowed and obscured by those of other serious diseases, so that the muscular hypertrophy is not suspected until discovered at autopsy.

CASE 1. The patient was a woman, aged 55 years, who complained of goiter, heart disease, dyspnœa, œdema, terrific coughing spells, nervousness, poor appetite, and loss of weight. Shortly after entering the hospital for treatment, and before there had been an opportunity to make a gastro-intestinal examination, she died suddenly of myocardial degeneration and decompensation. An autopsy was performed, and the pathological diagnosis included 18 items, among them chronic cholecystitis with cholelithiasis, acute diffuse appendicitis, and hypertrophy of the pyloric muscle.

Fig. 1. A case of congenital pyloric stenosis in a child 3 weeks old, operated upon with resultant complete relief. Pathologically this condition is the same as that exhibited in hypertrophy of the pyloric muscle in adults.

Pathological examination of the gastro-intestinal tract showed that the stomach was considerably contracted. The mucosa was grayish in color, with normal rugations, and velvety in consistency. No scars nor ulcers were found. The pyloric ring was markedly thickened, and the musculature was hypertrophied throughout the fundus. Microscopic examination showed marked thickening of the muscular coat of the pylorus, a few small areas of lymphocytic infiltration around the blood vessels, and a slight increase of fibrous tissue in the lower layers of the mucosa. Otherwise the muscle tissue appeared to be practically normal (Fig. 2).

Fig. 2. Hypertrophy of the pyloric muscle discovered at autopsy. The condition was not suspected before death, and a gastro-intestinal X-ray examination was not made. Case 1.

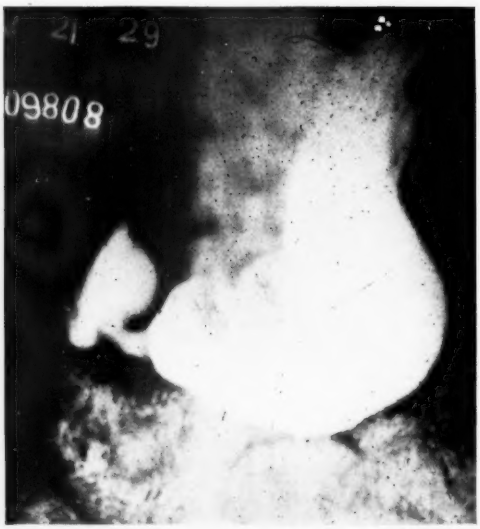
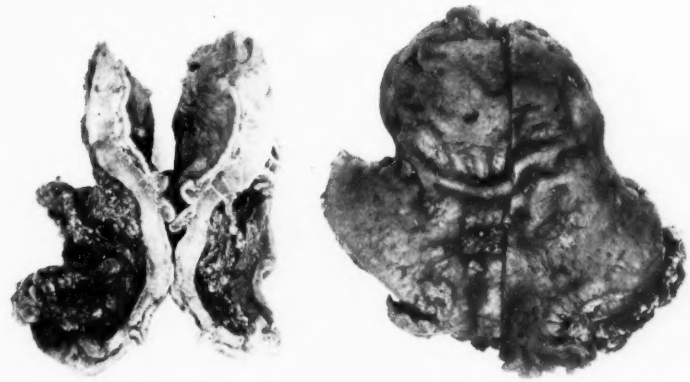


Fig. 3. Roentgenogram showing a smooth filling defect of the pars pylorica, interpreted before operation as carcinoma, but proved on pathological examination to have been caused by hypertrophy of the pyloric muscle. Case 2.

The 3 following cases illustrate how easily a mistake may be made in diagnosis, yet without disastrous results. In two of these cases the condition appeared to be of the congenital type, since symptoms had been present practically from the beginning of life. In two of the cases the possible association of the condition with ulcer is also interesting. In Case 3 an ulcer developed after operation, while in Case 4 there was pathological evidence of a healed lesion which may have been ulcer. This brings up the possibility of a common underlying factor in the production of hypertrophy and ulcer. Pirie has suggested that hyperadrenalism is the stimulating element in hypertrophy, while Crile has advanced the theory that hyperadrenalism may be a factor in the production of ulcer. This is a fertile field for investigation.

CASE 2. The patient was a woman, 36 years of age, who gave a history of life long indigestion, mor



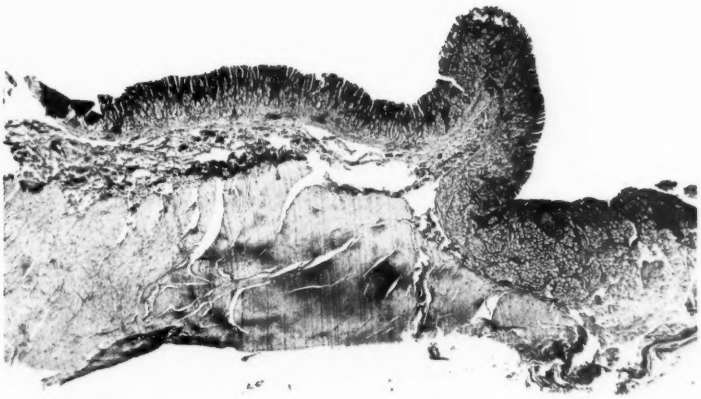


Fig. 4, above. Photographs showing two views of the gross specimen after resection of the pylorus. Case 2.

Fig. 5. Photomicrograph showing section through the hypertrophied pyloric muscle. Case 2. × 10.

severe during the preceding 10 years and gradually growing worse. For the preceding 3 years she had had attacks of epigastric pain, usually developing immediately after eating and relieved by vomiting. During this period she had lost 65 pounds.

X-ray examination of the stomach (Fig. 3) revealed a filling defect of the pars pylorica which was interpreted as due to carcinoma. The clinicians, however, believed it more probable that an ulcer was responsible, because of the duration of symptoms.

At operation, a marked thickening of the inferior portion of the pyloric ring could be felt, and apparently the lumen of the pylorus was very small as the fingers could not be passed through the ring. The lymph nodes along the greater curvature of the stomach seemed to be enlarged, but they were soft and did not have the gross characteristics of metastatic involvement. Partial gastric resection and posterior gastrojejunostomy were performed.

When the stomach was opened for pathological examination, a thickening of the entire wall was found which was most marked at the pyloric end (Fig. 4), where the wall measured 8 millimeters in thickness. The mucous membrane was thickened and somewhat irregular, but no ulcer was found in the region of the pyloric ring. There were several polypi on the gastric mucosa and 6.5 centimeters from the pyloric ring a small necrotic area was seen which was possibly a beginning ulcer. Longitudinal section along the greater curvature revealed marked thickening of the pyloric muscle for a distance of 3 centimeters from the duodenum, with increased fibrous tissue in the muscular coat. Both mucosa

Fig. 6. Roentgenogram showing a constriction at the pyloric ring, diagnosed before operation as congenital duodenal adhesions. This picture was made after the administration of atropine. Case 3.

and submucosa were of the same thickness throughout. Microscopic examination of a section through the gastroduodenal junction (Fig. 5) showed normal thickness of the duodenal wall, a slight diffuse inflammatory reaction in the mucosa, and hypertrophy of the superficial portions of the mucous glands. On the gastric side of the pylorus there was superficial ulceration of the mucosa, with atrophy of the gland and a diffuse inflammatory reaction in the mucosa and submucosa. The muscular wall of the stomach was greatly thickened. There were no enlarged lymph glands, and no evidence of malignancy or ulcer. The pathological diagnosis was chronic gastritis and hypertrophy of the muscular coat in the pyloric region.

Despite the continuing development of hyperthyroidism and anæmia after operation, the patient gained 43 pounds in 15 months and the gastrointestinal symptoms disappeared except such as could be attributed to her other conditions.

CASE 3. The patient was a woman, 44 years of age, who had suffered with indigestion and constipation practically all her life, but the symptoms had become worse during the preceding 2 years, with extreme distention and diffuse discomfort in the abdomen, especially the epigastrium, which developed about 3 hours after meals. Relief was obtained from food or alkalies, and the symptoms had been quiescent while the patient was on a Sippy diet and also while the diet was confined to vegetables. Physical examination revealed slight tenderness on deep palpation in the midepigastrium.

Fig. 7. Gross specimen removed from pyloric end of stomach, showing hypertrophy of the pyloric muscle. Case 3.

The first X-ray diagnosis was probable gastric ulcer, but after the administration of atropine to the physiological limit, the diagnosis was changed to congenital duodenal adhesions (Fig. 6).

At operation, an irregular thickening of the pylorus was found on its posterior surface toward the gastric side. It was impossible to determine whether or not ulcer was present, but partial gastric resection and gastrojejunostomy were decided upon because it was believed that the pyloric end of the stomach was diseased. The patient made a satisfactory operative recovery.

The pathological diagnosis was pyloric stenosis due to hypertrophy of the pyloric muscle. Grossly the pyloric band appeared somewhat thickened (Fig. 7). The mucous membrane did not show any areas of ulceration. Microscopically (Fig. 8), section of the stomach wall in the pyloric region showed thickening of the gastric mucosa, with diffuse increase of fibrous tissue and interglandular stroma. There was marked thickening of the muscular coats of the pyloric vein. No evidence of neoplasm, ulcer, or active inflammatory reaction was found.

Sixteen months later the patient returned, complaining of headache, gastric discomfort, and constipation. Roentgenographic examination showed that the stomach emptied readily through the artificial opening, but a 5 hour film showed retained barium at the gastro-enterostomy. An X-ray diagnosis of marginal ulcer was made and medical treatment was advised. The patient has not been seen since.

CASE 4. The patient, a man 45 years of age, complained of intermittent attacks of epigastric pain beginning at the age of 12 years. The pain occurred between meals, and sometimes was accompanied by nausea and vomiting. For one period of 6 years he had been free from attacks, but part of this time he was under treatment for pulmonary tuberculosis, which finally was pronounced arrested. Six years before our examination the pain had returned, with increasing severity, and a modified Sippy diet had given no relief.

Physical examination revealed spasticity of the abdominal muscles over the epigastrium and tenderness in the midline 3 centimeters below the xiphoid process. The X-ray diagnosis was duodenal ulcer without obstruction but with deformity of the duodenal bulb (Fig. 9).

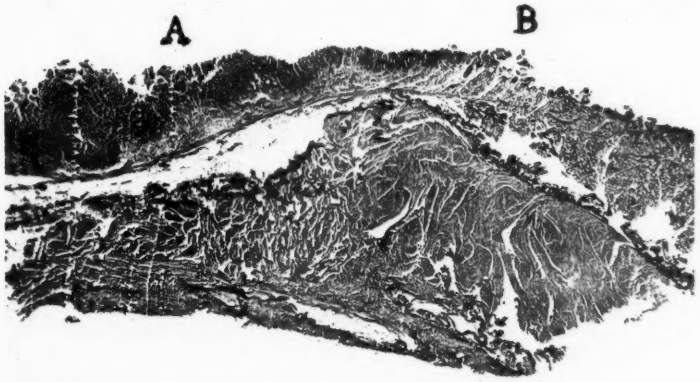


Fig. 8. Photomicrograph showing normal muscle tissue at *A* and hypertrophied pyloric muscle at *B*. Case 3. × 10.

At operation, the region of the pylorus was explored, and a large ulcer was thought to be present because of the amount of scar tissue on the gastric side of the pyloric vein. Gastric resection and gastrojejunostomy were performed, and the patient made a satisfactory recovery.

The pathological diagnosis was cicatricial stenosis of the pylorus and hypertrophy of the pyloric muscle. Grossly no scars were recognized. The pyloric wall was somewhat thickened, and there was a ringlike constriction. When the stomach was opened along the lesser curvature, a localized thickening was found at the pylorus. The mucosa of the stomach and duodenum appeared practically normal, and no active ulcers or scars were recognized (Fig. 10). Microscopically, sections of the pyloric region showed thickening of the stomach wall and a large amount of muscular tissue. There was no inflammatory exudate or scarring in the muscle. The submucous coat was not especially thickened. In the mucosa there was considerable lymphoid tissue, diffuse round cell infiltration, diffuse fibrosis of the interglandular stroma, and numerous eosinophils. The mucous glands were somewhat swollen but otherwise normal. Fibrosis and thickening of the submucous coat was most marked at the junction of the stomach and duodenum (Fig. 11).

Our fifth case illustrates the possibility of erroneous diagnosis when examination is made with the patient in only one position. Had examination in this case been made with the patient in only the upright posture, the pyloric defect could not have been observed.

CASE 5. This patient was a man, 31 years of age. Eighteen months before we first examined him, following some business reverses, his stomach had become sour and generalized abdominal soreness and tenderness had developed with vomiting when the pain became severe. The patient had lost 15 pounds in weight during this period. A gastric analysis 6 months after the development of symptoms had demonstrated hyperacidity. No tumor masses or tenderness had been felt in the abdomen, and the impression was that the patient was suffering from colitis and nervous hyperacidity. The only positive roentgenographic finding was reverse peristalsis in the duodenum and an unusually

Fig. 9. Roentgenogram showing a filling defect of the pylorus, diagnosed before operation as due to ulcer. Case 4.

Fig. 10. Two views of gross specimen after resection of the pylorus. Case 4.

large gas bubble in the stomach. At this time the patient was treated medically.

Twelve months later he returned, with no abatement of symptoms. The X-ray findings were similar to those of the previous year. Repeated changes of medication were made during the 3 years following. X-ray examination at the end of this period showed that the stomach was ptotic and dilated, that the duodenal bulb was slow in filling but regular, and that there were bands holding the second portion of the duodenum above the duodenal bulb.

Seven months after this examination the X-ray picture suggested the presence of chronic hypertrophic stenosis of the pylorus. With the patient in the erect posture the meal entered the stomach without delay. The stomach occupied a normal position and no deformity was apparent. The duodenal bulb filled smoothly. With the patient in the prone posture the picture was somewhat different. There was a narrowing of the pars pylorica for an inch and a half. This was constant throughout, as is shown in Figure 12. On a second fluoroscopic examination with the patient in the vertical position, the narrowing had disappeared. In the horizontal position it reappeared, but steady, gentle pressure produced a smooth appearance of the pylorus. There was some retention at the end of 5 hours.

It is apparent that the weight of the barium meal was sufficient to overcome the muscular constriction when the patient was upright. When he lay down, however, the hypertrophied muscle could assume its usual position. The constriction was smooth and would not be easily mistaken for a malignant lesion, especially since a filling defect was not constantly present. In such an examination it is essential that the patient be placed in a position which will eliminate deformity as a result of pressure from the spine.

The diagnosis at this time was hypertrophy of the pyloric muscle, and an exploratory operation was advised which has not been performed up to the time of this writing.

CASES REPORTED IN THE LITERATURE

As has already been stated, a review of the recent literature on this subject discloses a great paucity of material. Morton recently has reported 3 cases in each of which roentgenological studies of the gastro-intestinal tract disclosed characteristic changes in the pylorus, while exploration of the abdomen revealed hypertonicity and hypertrophy of the pylorus with narrowing of its lumen. In each case there was soreness of the abdomen, nausea and vomiting, and loss of weight. In none was there a palpable mass in the abdomen. Two of these patients were treated by plastic operation and were completely relieved of all symptoms. The third was treated by manual dilatation of the pylorus, and was only partially relieved for a time.

Archer has described 3 cases in which hypertrophy of the pyloric muscle was found

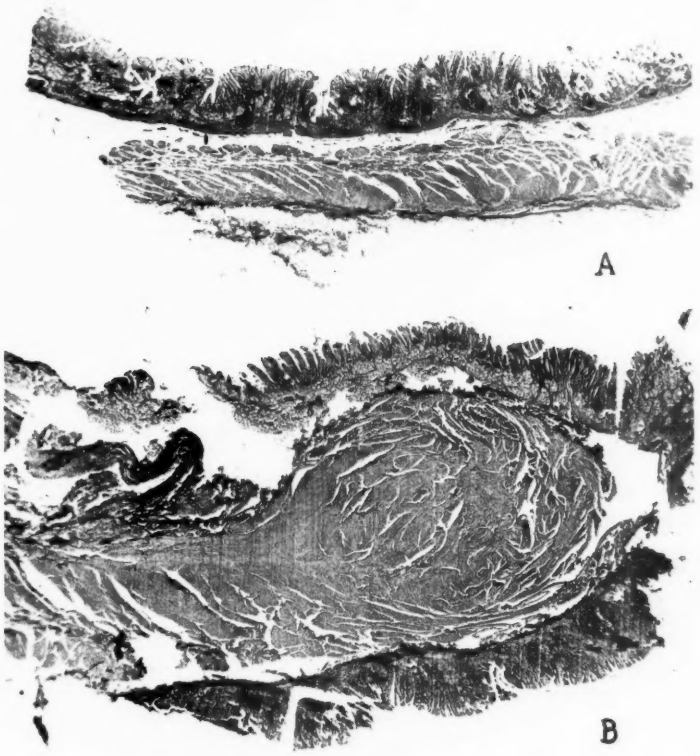


Fig. 11. Photomicrograph showing two views of the pyloric muscle: normal muscle, *A*, and hypertrophied muscle, *B*. Case 4. × 10.

at operation. The pre-operative diagnoses were respectively carcinoma, ulcer, and chronic appendicitis. In the last case, diagnosis on roentgen examination after appendectomy was "probable small ulcer." The duration of symptoms before advice was sought varied from 5 months to 1 year. A Rammstedt operation was performed in one case, the symptoms being mitigated, although the patient still has occasional nausea associated with fatigue but no vomiting. In the second case the pylorus was stretched manually. The patient improved after operation, but 5 months later the symptoms returned and pyloroplasty was advised. In the third case the anterior portion of the pyloric musculature was removed and a pyloroplasty was performed after the method of Horsley, Judd, and others. After operation this patient enjoyed the best health she had ever known.

Chaney, in 1928, reported a case in which, added to the usual symptoms, were jerky movements in the limbs, fine intermittent tremors of the head, especially involving the lips, difficulty in speech, slight protrusion of the eyeballs, and discoloration of the skin about the elbows, knees, and mouth. Despite a normal basal metabolic rate, thyroid extract was administered until the rate rose to 32 per cent, when the nervous manifestations disappeared. Pyloroplasty completely relieved all symptoms.

Crohn, in 1928, described a case which undoubtedly was congenital, since the symptoms had been present even in infancy, and had been mitigated by a low-residue diet.

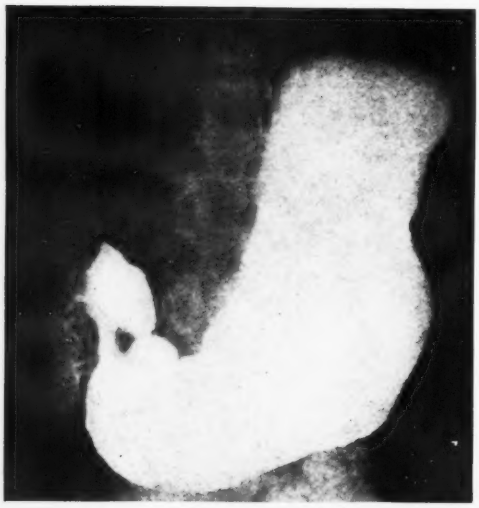


Fig. 12. Roentgenogram showing hypertrophy of the pyloric muscle. The presence of this condition has not as yet been confirmed by operation. Case 5.

This patient was cured by a retrocolic posterior gastrojejunostomy.

Ackman, in 1929, reported a most unusual case of congenital hypertrophic pyloric stenosis in a man aged 72 years. He had suffered from "stomach trouble" all his life and finally died of inanition as a result of vomiting due to narrowing of the pylorus. At autopsy the lumen was found to measure less than 3 millimeters.

In none of these cases, and in none of our own, was it possible to demonstrate clinically a palpable mass in the abdomen.

On gastric analysis the findings varied from anacidity to hyperacidity, so that deductions as to the rôle of acidity cannot be drawn. Infection was present in only 2 cases, and blood was found in the gastric secretion in only 2 cases. In none was there an ulcer found at time of operation.

CONCLUSIONS

Patients afflicted with pyloric stenosis present a varied and at times pitiful clinical picture. They seek aid from various physicians and are subjected to numerous roentgenological examinations, each physician feeling that ulcer or malignancy should be demonstrated, and when a negative report is returned, usually the condition is diagnosed as "nervous indigestion," and the common medications are prescribed, with very little resultant relief. When the true condition finally is diagnosed, relief really is in sight, for a plastic operation will give these people a new lease on life.

To prevent an erroneous diagnosis, it is important to differentiate this condition from a spastic pylorus. This may be done by the administration of atropine, preferably hypodermically. If the deformity seen roentgenologically is due entirely to pylorospasm, sufficient atropine will relax the musculature. If it is produced by hypertrophy of the pyloric muscle, even though the atropine will relax any accompanying spastic condition of the thickened muscle, it will not cause complete disappearance of the pyloric constriction.

While recognizing the interest and importance of determining the etiology of pyloric stenosis in adults, we urge the greater need of its recognition in every case in which it is present, and its appropriate treatment by a sufficiently radical operative procedure. Palliation by medical treatment only postpones the day when operation is imperatively required and prolongs the patient's sufferings.

NOTE.—Grateful acknowledgment is made of the assistance of Dr. Allen Graham in supplying pathological findings and photomicrographs illustrating these interesting cases.

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THE EFFECT OF EPHEDRIN ON THE CIRCULATION OF DOGS DURING SPINAL ANÆSTHESIA

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SINCE its introduction as a corrective measure for the fall in blood pressure occasioned by the use of spinal anæsthesia ephedrin has been extensively used.

In previous publications concerning the physiology of spinal anæsthesia we have shown that the fall in blood pressure which occurs as a result of the diminished peripheral resistance may be followed by diminished cardiac output. The diminution in cardiac output is not great until the pressure begins to reach relatively low levels (2). It was also demonstrated by Burch, Harrison, and Blalock (3) that animals in which spinal anæsthesia has been induced, stand hæmorrhage poorly. This is a result of vasomotor weakness. It is well known that one of the compensatory mechanisms for hæmorrhage is vasoconstriction. We have demonstrated that in dogs under spinal anæsthesia the vasoconstriction response to hæmorrhage is absent (4). Hence, during spinal anæsthesia the mechanism compensating for hæmorrhage is disturbed.

Fluid as a corrective measure has been studied (5), and it seemed worth while to us to investigate also the effect of ephedrin on the circulatory system during spinal anæsthesia.

Dogs were anæsthetized with barbital. A carotid cannula was inserted and was connected to a mercury manometer. The technique used for the measurements of arterial tone and of cardiac output have been described in our previous papers.

Spinal puncture was usually done in the upper lumbar segment and we have experienced no great difficulty in doing this on most anæsthetized dogs. Ephedrin was given intravenously and intraspinally in doses of 2 to 5 milligrams per kilogram of body weight.

In Table I are shown the effects of injecting ephedrin into the blood stream. The mean blood pressure increased in each instance, the degree of increase being most marked when the pressure was not extremely low before the drug was given. In no instance did the mean blood pressure rise to a level above the original control value before spinal anæsthesia had been induced. The cardiac output was usually much increased after ephedrin, and the degree of increase was usually greater than that found in normal dogs by Wilson, Pilcher, and Harrison (6). The rises in cardiac output and blood pressure were sustained for 30 minutes or longer in most of the experiments.

The results of the administration of ephedrin intraspinally are shown in Table II. When ephedrin was given intraspinally to a dog which had previously received spinocaine, the blood pressure rapidly rose to a value equal to or above the normal pressure for that animal. The subsequent administration of large amounts of spinocaine caused no decrease in blood pressure, although most of the animals died of respiratory paralysis after receiving extremely large doses of spinocaine. When ephedrin was administered prior to spinocaine no decline in blood pressure occurred even though successive large doses of spinocaine were given.

These data seem to indicate that in dogs ephedrin intraspinally is superior to ephedrin intravenously in the prevention of the fall in blood pressure caused by spinal anæsthesia. The exact nature of the pharmocological action of ephedrin in this connection is not clear. Possibly the effect is due to absorption of the drug from the spinal fluid into the blood stream over a considerable period, possibly to an action on vasomotor fibers as they leave the cord.

The data in Table III show that the intravenous administration of ephedrin is followed by a marked decrease in perfusion rate, i.e., by an increase in arterial tone.

In Table IV are shown five experiments in which dogs under spinal anæsthesia were given ephedrin and then bled. The animals withstood withdrawal of from 15 to 40 cubic centimeters of blood per kilogram. It has been

TABLE I.—THE EFFECT OF EPHEDRIN ON BLOOD PRESSURE AND CARDIAC OUTPUT

Experiment number	Control period	After spinal anæsthesia		After ephedrin			Mode of administration of ephedrin
	Mean blood pressure, mm. Hg.	Mean blood pressure, mm. Hg.	Cardiac output per minute, c.cm.	Time after ephedrin in minutes	Mean blood pressure, mm. Hg.	Cardiac output per minute, c.cm.	
15	146	56		2 30 50	128 106 116		Intravenous
16	124	70	1180	5 35	100 102	1560 1730	Intravenous
17	108	56	1110	7 50	107 87	1540 1930	Intravenous
18	116	59	850	15	70	880	Intravenous
19	124	34	1110	7 45	80 50	1780 2420	Intravenous
20	104	42	710	5 50	88 28	2240 810	Intravenous
21	88	34	230	12 45	68 84	2750 590	Intravenous

TABLE III.—THE EFFECT OF EPHEDRIN INTRAVENOUSLY ON THE PERFUSION RATE OF THE HIND LEGS OF DOGS

Experiment number	Before ephedrin		After ephedrin	
	Mean blood pressure, mm. Hg.	Perfusion rate per minute, c.cm.	Mean blood pressure, mm. Hg.	Perfusion rate per minute, c.cm.
29	83	94	115	60
31	88	103	165	32
32	52	145	107	34

shown by Blalock (1) that normal dogs die when bled 30 to 50 cubic centimeters per kilogram of body weight. Burch, Harrison, and Blalock (3) found that dogs which were under spinal anæsthesia and which had not received ephedrin died when bled 8 to 16 cubic centimeters per kilogram. Therefore, ephedrin markedly decreases the susceptibility to hæmorrhage of dogs under spinal anæsthesia.

SUMMARY

1. Ephedrin *intravenously* caused a rise in the blood pressure and the cardiac output of dogs under spinal anæsthesia.

2. Ephedrin *intraspinally* caused an even greater rise in blood pressure. The previous administration of ephedrin intraspinally abolished the usual vasomotor effect of spinocaine.

3. The arterial tone was increased in dogs by ephedrin.

TABLE II.—THE EFFECT OF EPHEDRIN INTRASPINALLY ON THE BLOOD PRESSURE

Experiment number	Control period before spinal anæsthesia—mean blood pressure, mm. Hg.	After spinal anæsthesia—mean blood pressure, mm. Hg.	After ephedrin—mean blood pressure, mm. Hg.	Remarks
36	158	114	190 (10 min.) 160 (1 hr.)	Respiratory paralysis after 6 c.cm. spinocaine
40	130	90	228 230 (10 min.)	Respiratory paralysis after 2 c.cm. spinocaine
41	92	64	90 (15 min.)	
		After ephedrin; mean blood pressure, mm. Hg.	After spinal anæsthesia; mean blood pressure, mm. Hg.	
37	102	106	112 120 124 118 130	Total spinocaine—c.cm. ½ 1¼ 2¼ 3¼ Respiratory 4¼ paralysis
38	140	136	136 134 138 145 132 136	1 2 3 4 5 Respiratory 6 paralysis
39	100	98	90	

TABLE IV.—THE EFFECT OF EPHEDRIN ON THE SUSCEPTIBILITY TO HÆMORRHAGE OF DOGS UNDER SPINAL ANÆSTHESIA

Experiment number	Weight of dog, kilograms	Total amount bled before death occurred, c.cm.	Amount bled, c.cm. per kilogram	Remarks
16	10	300	30	Ephedrin intravenously
19	8	120	15	Ephedrin intravenously
21	10	315	31	Ephedrin intravenously
39	10	300	30	Ephedrin intraspinally
40	15	600	40	Ephedrin intraspinally

4. The administration of ephedrin to dogs under spinal anæsthesia decreased the susceptibility of such animals to hæmorrhage.

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CICATRICIAL (BENIGN) STRICTURE OF THE ŒSOPHAGUS OF UNKNOWN ORIGIN

Report Based on Forty Cases

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ANY inflammatory reaction in or around the œsophagus may result in œsophageal stricture. The majority of cicatricial strictures are due to swallowing of some caustic substance such as household lye, whereas others have followed infections of childhood, typhoid fever, vomiting of pregnancy, and so forth.

After all the known causes of benign stricture of the œsophagus have been enumerated, there remains a fairly large group of cases in which there is no apparent etiological factor.

Œsophageal ulceration occurs more frequently than generally is recognized, but in most instances the inflammatory reaction is superficial, and when healing occurs the lumen of the tube is not reduced enough for dysphagia to be produced. Frequently considerable ulceration is encountered in the œsophagus, associated with an impacted foreign body; yet in only one instance have I observed development of stricture following removal of the foreign body.

Caustic substances seem to have the power to injure the deeper portions of the œsophageal wall, and a very small quantity of a solution of lye may produce multiple dense strictures, whereas strictures of ordinary inflammatory origin are usually single, short, and not particularly dense. So-called peptic ulcer of the œsophagus has been described, and one might attribute development of a benign stricture of the œsophagus to the healing of a lesion of this type, with secondary contraction of the lumen of the œsophagus. However, few of the patients who have strictures of unknown origin have had any symptoms preceding the onset of dysphagia, and most of them have not experienced pain or a substernal burning sensation after the onset of their illness. Since pain and substernal burning have been described as cardinal symptoms of peptic ulcer of the œsophagus, it is unlikely that peptic ulcer is a common etiological factor in stricture.

The onset of dysphagia in the cases which form the basis of this report was usually insidious, but in one case it was sudden and followed a period of fever, associated with vomiting of pus and blood. It seemed in this case that it had resulted from healing of a mediastinal abscess. In one case stricture developed following an attack of acute suppurative appendicitis and in another case, previously reported (2), apparently perforation of the œsophagus developed following physical strain, and a mediastinal abscess and secondary stricture formed.

In a previous report (1) from The Mayo Clinic, of 186 cases of benign œsophageal stricture, 18 (less than 10 per cent) were of unknown

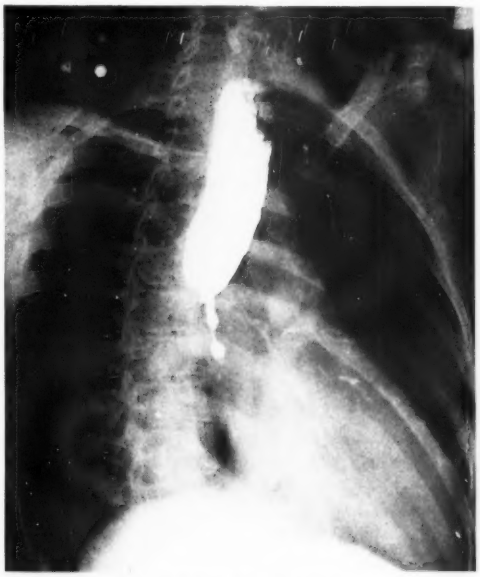

Fig. 1. Benign stricture of the œsophagus considered malignant on roentgenologic examination.

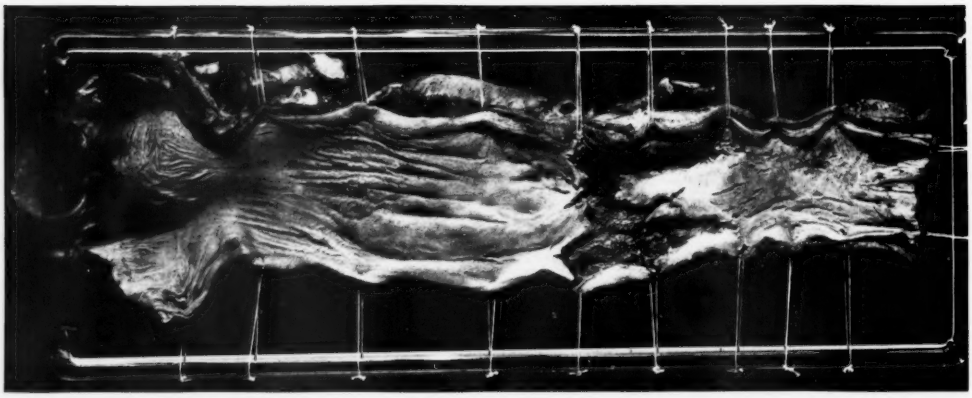

Fig. 2. Œsophagus removed at postmortem examination. The patient succumbed to myocardial disease. The dysphagia was completely relieved by dilatation.

origin. Up to January 1, 1930, 243 cases of benign stricture of the œsophagus were observed, and in 40 of these the cause of the stricture could not be determined. This represents a rather striking increase in the relative number of patients who have benign stricture of the œsophagus of unknown origin, and presents a problem in distinguishing this condition from malignant disease of the œsophagus.

Seventeen of the 40 patients were males and 23 were females. The ages ranged from 6 to 75 years. In 9 cases the stricture was in the upper third of the œsophagus (18 to 25 centimeters from the incisor teeth); in 10 cases, in the middle third (28 to 33 centimeters from the incisor teeth), and in 21 cases, in the lower third (35 centimeters from the incisor teeth to the cardia). The duration of symptoms was 6 weeks to 11 months in 8 cases, from 1 to 2 years in 10 cases, from 3 to 5 years in 10 cases, from 6 to 16 years in 6 cases, more than 17 years in 5 cases, and "many years" in 1 case.

Dysphagia was present in varying degree in all of the cases. In one case there was complete obstruction of the œsophagus and gastrostomy had been performed elsewhere 18 years previously. As in other cases of benign stricture, the degree of dysphagia varied according to the size of the lumen of the stricture.

Pain was experienced by 24 of the patients, but 5 had pain at the onset of symptoms only and 4 others did not note it, except during the act of swallowing or when a bolus of food became obstructed at the site of the stricture. In 3 cases, the pain was similar to that experienced by patients who suffer from gastric or duodenal ulcer, and in two of these a duodenal ulcer was demonstrated on roentgenoscopic examination. The pain was relieved in most instances by dilating the stricture. The pain was attributed to associated œsophageal spasm rather than to active ulceration in the œsophagus. Regurgitation was frequent. Ten of the patients had noted blood in the material ejected from the œsophagus; as a rule this was small in amount, but one patient had vomited about 500 cubic centimeters of bright red blood.

Roentgenoscopic examinations of the œsophagus were made in 38 cases, and in 7, obstruction was not detected. In 4 cases, the obstruction was considered to be caused by a malignant lesion (Figs. 1 and 2), in 1 case it was thought to be due to cardiospasm, and in 1 to pharyngoœsophageal diverticulum. The stricture was single in all cases.

Eighteen of the patients were examined with the œsophagoscope, and all the lesions appeared to be benign. Active ulceration was demonstrated in the scar in 2 cases, but in one of these the examination was made within a week after the stricture had been dilated, and it was considered to be traumatic in origin. A second examination at a later date revealed complete healing.

The insidious onset of œsophageal obstruction without apparent cause always suggests the presence of carcinoma and in every case this diagnosis was considered. Many of the patients had been given a diagnosis of œsophageal carcinoma before they came to the clinic for examination. One patient who had been given a hopeless prognosis had attempted suicide (Fig. 3). The combination of a rather long history of dysphagia, without marked progression, in a case in which the patient is fairly well nourished always should suggest that the lesion is benign. If a careful roentgenoscopic examination fails to reveal obstruction, or if the stricture produces a smooth outline, one has additional evidence that the obstruction is not malignant. If, also, the stricture is short and appears not to be malignant when it is observed through the œsophagoscope, it should be considered to be benign.

It is sometimes impossible to prove the presence of carcinoma by microscopic examination of tissue removed from the œsophagus. If one is inclined to advocate gastrostomy in the treatment of carcinoma of the œsophagus, it is likely that a needless operation of this type will be done on some of the patients who have benign stricture of unknown cause. However, if one recommends dilatation of malignant as well as of benign œsophageal strictures, it follows that all cases of benign stricture will be properly treated and that the elapse of sufficient time will settle any question as to the accuracy of the diagnosis. At any rate, one should never make an absolute diagnosis of œsophageal carcinoma unless the tissue which has been removed from the œsophagus has been proved to be carcinomatous by means of the microscopic examination of sections.

Thirty-nine of the patients were treated by dilatation, without a death and with excellent functional results. The strictures were gradually dilated to a size 45 F., with sounds passed over a swallowed silk thread. One of the patients had a complete stenosis of the œsophagus and therefore no attempt was made to establish an opening through the scar tissue.

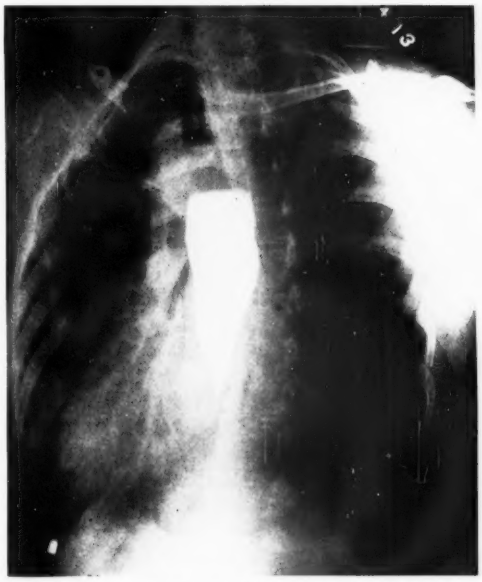

Fig. 3. Benign stricture of the œsophagus of unknown origin. Bullet is shown in the lung, the result of attempted suicide following a hopeless prognosis.

SUMMARY

Benign stricture of the œsophagus of unknown origin occurs rather frequently. This report is based on 40 cases.

In more than half of the cases, the stricture is in the lower third of the œsophagus and is single, short, and not particularly dense.

The chief symptom is dysphagia, but pain and regurgitation of blood may be present.

The history and results of examination may suggest malignant disease of the œsophagus, and absolute diagnosis may be difficult.

Roentgenoscopic examination may give negative results or may suggest other lesions than benign stricture.

Dilatation for both malignant and benign stricture of the œsophagus is advocated.

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FURTHER OBSERVATION ON THE TRANSPLANTATION OF THE EPIPHYSEAL CARTILAGE PLATE

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FROM a series of experiments on the transplantation of the epiphyseal cartilage plate which were reported in two papers in 1915 and 1916, I concluded that the epiphyseal cartilage plate, either alone or with an adjoining piece of the epiphysis or diaphysis, lost its power to produce length growth. This conclusion was not in agreement with the previous work of Helferich, Rehn and Wakabayashi, von Tappeiner, Obata, or Heller, who reported from their observation that they had obtained varying degrees of length growth, especially after reimplantation of the epiphyseal cartilage plate.

Heller, in a subsequent article published in 1917, reported a further series of about 120 experiments in which he transplanted a very thin piece of the epiphyseal cartilage plate, being very careful, checking with magnifying glass, to take as little as possible of the adjoining osseous tissue. In one set of experiments he merely reimplanted the cartilage in its normal position after excision from the lower end of the ulna. A wire marker was placed in the diaphysis to determine in which direction growth took place. He found in the reimplantations that there was practically normal growth of the extremity operated upon. In a second set of experiments, the epiphyseal plate was excised and then reversed before reimplanting, so that the side that normally faced the diaphysis was next to the epiphysis. He found that there was an abnormal increase in growth on the epiphyseal side so that the epiphysis was much longer than normal, but in general there was a retardation of growth. In homotransplantation between non-related rabbits there was some increase in growth but in general there was a marked retardation. In another group of experiments, he reimplanted the boiled epiphyseal plate and in 2 cases got as much as 1.0 centimeter increase of length. He concluded from these results that autoplastic reimplantation of the epiphyseal plate was successful and offered a good chance for favorable application in man.

In 1929, Straub reported a clinical result under the title of "Anatomical Survival Growth and Physiological Function of an Epiphyseal Bone Transplant."

The patient, a boy of 4½ years, had an acute osteomyelitis of the tibia, during which practically the entire lower half of the tibia, including the epiphysis, sequestrated. Two years later a piece of bone 13 centimeters long was removed from the anterior part of the internal malleolus of the normal tibia, including the epiphyseal cartilage plate. This section of the bone was implanted into the defect in the lower end of the opposite tibia which was destroyed by the osteomyelitis. The upper end of the graft was fixed to the tibia by a silver wire. This boy was followed for 16 years and at the age of 20 years there was excellent function of the leg with 5 centimeters in shortening as compared to 4.5 centimeters in 1914.

Straub concluded that the transplantation of the piece of bone was successful in so far as the survival of growth and function of the epiphysis was concerned. One cannot help being impressed with the almost normal restoration of the form of the lower end of the tibia; but careful study shows that there has not been any appreciable length growth in the transplanted segment of bone. The silver wire which was placed about the transplant at the time of the operation is the same distance from the lower end of the tibia after the elapse of 16 years as it was at the time of insertion. Remembering that the greatest growth takes place normally at the upper tibial epiphysis, it is possible that additional compensatory growth accounts in part for the almost equal growth during the latter years on the two sides.

A few months later an article appeared by Fohl in which he reported the results of his experimental transplantation of the epiphyseal cartilage plate with a piece of the

diaphysis as giving almost normal growth. In two experiments in this same series there was a very marked shortening and three complete failures but he does not offer any explanation for the discrepancies. In another series he transplanted the epiphyseal cartilage plate with the entire epiphysis. In 2 experiments there was full bone growth; in 3 cases there was moderate shortening—two without bowing of foot and one with bowing of foot. In one case there was full loss of growth and marked bending of foot. The tables he presents are not convincing and there are several mathematical errors. In one experiment he transplanted the epiphyseal cartilage plate in an ape and got normal growth. Fohl concluded from his experiment that the substitution of a lost epiphyseal cartilage plate by a transplanted cartilage plate, plus a piece of the diaphysis, has a practical clinical application.

Following the publication of these articles of Straub and Fohl, renewed interest was excited in this interesting subject. Feeling that my original findings were possibly incorrect I thought it advisable to repeat Fohl's experiment, also those of Heller. If the findings of Fohl and Heller are correct then one is justified in attempting to carry out such a procedure in man with expectations of obtaining successful results. On the contrary, if they are wrong then one should not attempt to transplant the epiphyseal cartilage plate and submit the patient to a needless operation.

In our endeavor to present further evidence for or against the transplantation of the epiphyseal cartilage plate, the following group of experiments was performed upon young, growing rabbits:

1. Reimplantation of the epiphyseal cartilage plate with a very thin layer of adjoining osseous tissue.
2. Reimplantation of the reversed epiphyseal cartilage plate.
3. Reimplantation of the entire epiphysis and epiphyseal plate.
4. Reimplantation of the epiphysis with the varying lengths of the diaphysis.
5. Reimplantation of the epiphyseal plate with a portion of the epiphysis and diaphysis.
6. Reimplantation of the epiphysis and piece of diaphysis with epiphyseal cartilage plate destroyed.
7. Check experiments in which the epiphyseal cartilage plate of both radius and ulna was destroyed.

1. Reimplantation of the epiphyseal cartilage plate. Under ether anæsthesia, an incision was made on the dorsum of forefoot near the lower end of the ulna. The epiphyseal cartilage plate of the ulna was exposed. The epiphyseal plate was then excised with a very thin layer of adjoining osseous tissue, a sharp scalpel being used to make the cuts through the periosteum and osseous tissue. After the plate was removed it was reinserted and held in place by suturing the overlying tissue. In order to determine the exact amount of growth at either end, one or two silver shots were placed in the cortex of the diaphysis. After completion of the operation a roentgenogram was made so that at a later date it could be used for determining the amount of growth. At the end of the desired experimental period the animal was sacrificed in the gas chamber. There were 5 experiments in this series (Fig. 1). The findings are given in Table I.

TABLE I.—REIMPLANTATION OF THE EPIPHYSEAL CARTILAGE PLATE

No. of experiment	Duration of experiment, days	Growth of bone operated upon, cm.	Growth of normal bone, cm.	Growth on epiphyseal side of marker in bone operated upon, cm.
5	28	0.3	0.6	0
22	141	2.1	3.2	1.7*
6	168	0.5	2.6	0
7	168	0.4	2.8	0
1	211	0.4	1.3	0.1

*Part of plate not removed.

In only one experiment, No. 22, was there over 0.5 centimeter of growth while the normal growth was five times that amount. In experiment No. 22 there was a definite growth on the epiphyseal side of the marker. In the description of the operation it was stated that the cut passed diagonally through the plate and some of the cartilage was not excised. In view of the fact that there was no growth in the 4 other experiments it is

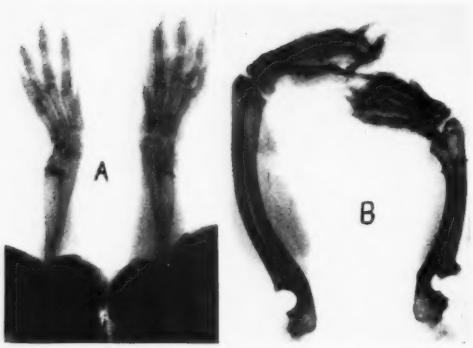

Fig. 1. Experiment 7. Reimplantation of the epiphyseal cartilage plate. At the end of 168 days the ulna operated upon had increased but 0.4 centimeters while the normal growth was 2.8 centimeters. Compare the right leg operated upon with the normal left leg. A, At time of operation both legs of equal length. B, Notice marked shortening of the leg operated upon with the markers in the bones.

more than likely that the growth in experiment 22 was due in part to epiphyseal cartilage that remained behind.

It is difficult to explain the wide discrepancies between Heller's findings and those of present experiments. In a similar set, Heller found almost complete growth after the reimplantation of the cartilage plate. The difference in the results may be due to a variation in the method of removal of the epiphyseal cartilage. If Heller did not remove all of the plate, the remaining cartilage cells could proliferate with resulting increase in length of bone. Heller obtained growth after boiling the plate so it is more than likely that he did not remove the entire plate. One should keep in mind the fact that the cartilage plate is not a perfect cylinder but its borders are curved and irregular. In a straight, transverse cut close to the margins of the plate some cartilage cells may not be removed. On the other hand, it may be claimed that in my experiment too much osseous tissue was removed with the plate and the adhering osseous tissue prevented the access of nourishing tissue fluids of the transplanted cartilage which were necessary for its proliferation. In removing the plate extreme care was taken so that a very thin layer of osseous tissue was removed.

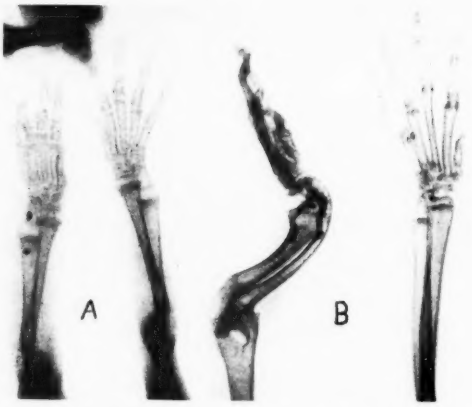

Fig. 2. Experiment 18. Reimplantation of the reversed epiphyseal cartilage plate. At the end of 147 days the ulna operated upon had increased 0.5 centimeters while the normal bone grew 3.3 centimeters. Compare the position of the shots at time of operation in A with those in B at the termination of experiment. There has been no growth at the distal epiphyseal plate. A, Notice equal length of both legs at operation. B, Notice marked shortening of leg operated upon at end of experiment.

Reversing the reimplanted epiphyseal cartilage plate. An incision was made over the dorsal surface of the lower end of the ulnar bone and dissection was carried down to the epiphyseal cartilage plate. The cartilage plate, with a very thin section of osseous tissue, was then excised. The plate was reversed so that the side toward the epiphysis faced toward the diaphysis and was then reimplanted. A silver marker was placed in the diaphysis. The overlying tissues were brought together, an adhesive plaster dressing was applied to the foot, and the animal was allowed to go about after recovery from the anæsthetic. At the completion of the experimental time the animal was sacrificed (Fig. 2). The results are shown in Table II.

SUMMARY

In only one experiment was there any growth. In this experiment the anterior part of the plate was not removed, which could account for some of the growth, although not the entire amount. It is impossible to explain why there is absolutely no growth in any of the others and an increase in length in this experiment. Heller found uniformly growth in bones

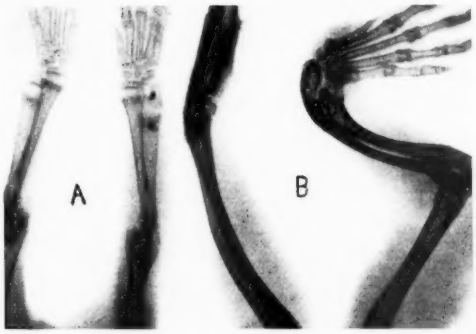

Fig. 3. Experiment 21. Reimplantation of the entire epiphyseal end of the bone including the epiphyseal cartilage plate. Growth of bone operated upon at the end of 120 days, 0.6 centimeters. Growth of normal bone, 3.2 centimeters. No growth distal to the shots. A, At operation. B, At end of 120 days.

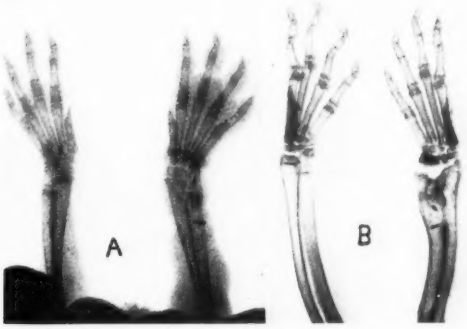

Fig. 4. Experiment 8. Reimplantation of the entire epiphysis with a piece of the diaphysis. 158 days. Growth of bone operated upon, 2 centimeters. Growth of normal bone, 2.1 centimeters. The epiphyseal cartilage plate of the radius was destroyed also in this experiment. Compare the bones at time of operation in A with those at the end of 158 days in B.

in which the plate was reversed. In the series reported here in which the entire plate was removed no growth took place. It is possible that Heller did not transplant the entire plate with the cartilage columns. That such may be the case is supported by his own experiments in which he obtained an appreciable growth even after he had destroyed the cartilage plate by boiling before reimplanting.

Reimplantation of the entire epiphysis including the epiphyseal cartilage plate. The distal end of the ulnar bone was exposed by an incision on the dorsal surface of the foot. A cross cut was then made through the metaphysis and the distal end of the bone was removed, after which it was reimplanted in its original position. A silver marker was placed in the diaphysis. The wound was closed in layers, an adhesive dressing was applied, and, after recovery from the anæsthetic, the animal was allowed its freedom (Fig. 3).

There was absolutely no growth in the reimplanted bone in either one of the two experiments. This is in direct opposition to the results obtained by Fohl in his reported experiments. I can offer no explanation except that it is possible that Fohl's incision passed distal to the cartilage columns, which, not being disturbed very much, functioned in a normal manner.

Reimplanting of the entire epiphysis with an adjoining piece of the diaphysis. Through a dorsal incision in the lower end of the foot the distal portion of the ulna was exposed. A cut was made several centimeters proximal to the epiphyseal cartilage plate, after which the entire distal end of the bone was removed and then reimplanted in its normal position. The wound was closed in layers, an adhesive

TABLE II.—RESULTS OF REVERSING THE EPIPHYSEAL CARTILAGE PLATE

No. of experiment	Duration of experiment, days	Growth of operated bone, cm.	Growth of normal bone, cm.	Growth toward epiphyseal end from marker, cm.
12	8	0	0	0
11	22	0	0	0
13	140	1.0	2.0	4*
17	147	0.8	3.7	0
18	147	0.5	3.3	0
16	149	2.7	3.8	2.1†

*Non-union with gap between fragments.
†Anterior portion of plate not removed.

TABLE III.—RESULTS OF REIMPLANTING THE ENTIRE EPIPHYSEAL END OF BONE INCLUDING THE EPIPHYSEAL PLATE

No. of experiment	Duration of experiment, days	Growth of operated bone, cm.	Growth of normal bone, cm.	Growth distal to marker in operated bone, cm.
21	120	0.6	3.2	0.0
4	190	0.5	1.3	0.0

dressing was applied, and the animal allowed its freedom (Fig. 4).

TABLE IV.—RESULTS IN REIMPLANTATION OF THE ENTIRE DISTAL END OF THE BONE INCLUDING A PIECE OF THE DIAPHYSIS

No. of experiment	Duration of experiment, days	Growth of operated bone, cm.	Growth of normal bone, cm.	Growth, distal to marker, cm.
15	15	0.0	0.0	0
8	158	0.2	2.1	0
9	168	0.3	2.1	0
2	211	0.2	1.5	0

In none of the experiments was there any growth in the distal reimplanted end of the bone (Table IV).

These results are in accord with experiments reported in a previous article. They also differ from those of Fohl who reported growth in a set of experiments which were somewhat similar.

Reimplantation of the epiphysis and a piece of diaphysis in which the cartilage plate was destroyed. The distal end of the ulna was exposed through an incision on the dorsum of the foot. The distal end of the bone, including a piece of the diaphysis and the entire epiphysis, was removed. The epiphyseal cartilage plate was destroyed by cauterizing with a hot wire. The segment of bone was reimplanted and the wound closed in layers. An adhesive plaster dressing was applied and the animal was allowed its freedom.

TABLE V.—RESULTS OF REIMPLANTED DISTAL END OF BONE WITH DESTROYED EPIPHYSEAL CARTILAGE PLATE

No. of experiment	Duration of experiment, days	Growth of operated bone, cm.	Growth of normal bone, cm.	Growth, distal to marker, cm.
14	137	0.2	2.0	0
10	140	0.4	2.3	0

There was no growth in distal end of bone after transplantation.

These experiments were performed before the previous series was completed. Knowing that no growth took place with the epiphyseal cartilage plate intact, one could have anticipated a failure of growth in these particular experiments.

Cauterization of the distal epiphyseal plate of radius and ulna without transplantation. The lower end of the ulna and radius was exposed through an incision on the dorsum of the foot. The cartilage plate of both the radius and ulna was destroyed with a hot wire.

TABLE VI.—RESULTS OF CAUTERIZATION OF EPIPHYSEAL PLATE OF RADIUS AND ULNA

No. of experiment	Duration of experiment, days	Growth of operated bone, cm.	Growth of normal bone, cm.	Growth, distal to marker, cm.
19	117	0.5	3.0	0
20	141	0.6	3.2	0

This experiment shows the growth that takes place at the upper epiphysis of the ulna. Comparing the growth at upper end with normal growth of the ulna, it is found to be about one-fifth of that which occurs from the lower epiphysis. This agrees with Ollier's findings on the same subject.

DISCUSSION OF RESULTS OF EXPERIMENTS

In this entire set of over twenty experiments there were only two instances in which growth took place after transplantation of the epiphyseal cartilage plate. In both of these experiments it was noted that the plate had not been completely excised at the time of the operation. It is difficult to explain the discrepancies between these findings and those of Heller. It is possible that Heller did not completely excise the cartilage plate and that the remaining cartilage accounted for at least some increase in growth. This is more than could be ascribed to the growth at the proximal epiphysis and tends to support the assumption that he did not completely excise the cartilage plate at the time of reimplantation. The findings in the present series do not agree with those of Fohl in which he reported full length growth in two cases where he transplanted the epiphyseal cartilage plate with a piece of the diaphysis. He also obtained normal growth in two experiments where he transplanted the entire epiphysis with the epiphyseal cartilage plate. It is difficult to explain why I have failed to obtain any growth in similar experiments. It is possible that technical errors or misinterpretation of results may account for

the variation in results. It is to be hoped that the reports of other investigators will throw light on this problem and that an agreement of opinion may be obtained from further study. From previous investigations and the present I am forced to the conclusion that the epiphyseal cartilage plate loses its power of causing length growth after transplantation.

CONCLUSIONS

1. The epiphyseal cartilage plate loses its function of producing length growth after transplantation.

2. Unless more definite experimental evidence is presented to prove the viability of the epiphyseal cartilage plate after transplantation one is not justified in attempting such a transplantation in man with the expectation of obtaining length growth.

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THE DIAGNOSIS OF DISPROPORTION

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Some idea of the unsatisfactory results of the usual methods for determining and treating disproportion in obstetrics is gained from the recent statement by Fitzgibbon, who writes (3): "At present the number of women treated by induction of labor and cæsarean section is greater than the number of women who suffered from dystocia before the perfection and universal adoption of these methods of treatment, but the number of craniotomies, difficult deliveries, and disastrous results of delivery with the forceps is not diminished. It suggests that the application of operative interference for the purpose of avoiding dystocia is not wholly confined to cases calling for such treatment, while it is undoubtedly not applied to many cases in which it would be of benefit."

In the present communication, it is the purpose of the author to review briefly the methods now in general use in the diagnosis of disproportion and to emphasize the value of the roentgenologic methods used in this clinic. It is not proposed to discuss at this time the various methods of treating disproportion when its existence has been demonstrated.

The problem of disproportion resolves itself into two factors: the size of the fetus and the size of the pelvis. When other conditions are normal but the latter are mutually incompatible from an obstetrical viewpoint, disproportion exists. Furthermore, in the great majority of cases, disproportion is unassociated with unusual pelvic malformation, but occurs in individuals whose pelvic diameters deviate only slightly from normal.

In a given case, therefore, in which disproportion exists because of the inadequate size of the maternal pelvis, there is generally to be

found (1) a moderately equally contracted pelvis, (2) a moderately flattened one, or (3) a pelvis within the lower limits of normal. Therefore, in considering the usual pelvic contractions found in cases of disproportion, it is helpful, by means of the accompanying drawing (Fig. 1), to visualize them in relation to the normal superior strait. *A* in this figure represents the moderately equally contracted pelvis present in persons of small stature in most races, and the most frequent type of contracted pelvis in the black race. In evaluating a pelvis of this type, both anteroposterior and transverse diameters appear to be of equal importance. Transverse room is most essential if consistency with the size of the fetus is to be preserved. This type of pelvis is very often associated with rachitic changes, and evidences of the lesions should be sought for, especially in the contour of the anterior surface of the sacrum. Here direct vaginal palpation and roentgenologic examination are of great value. *C* in Figure 1 represents a combination of the generally contracted and flat pelvis. This is often the result of the superimposition of rachitic changes in childhood upon the pelvis of an individual of small stature.

In considering disproportion in association with these abnormal pelvic changes, we should bear in mind the premise that the average fetus, of 3,000 to 3,500 grams, 48 to 51 centimeters in length, with an occipitofrontal diameter 11 to 12 centimeters and biparietal diameter 9 to 9.5 centimeters is for practical purposes always obstetrically compatible with the normal sized pelvis.

In the investigation of the individual case, there are certain points other than the maternal pelvic and fetal cephalic relationships which often furnish important information. The stature and gait of the individual may be studied with profit. The familial physical characteristics of both husband and wife may be important. A husband or a wife of small stature who comes from a family in which large stature is a dominant factor may transmit this latter characteristic to the offspring. In this country, where intermarriage of different racial stocks is common, one often surmises that the principal etiological factor in certain cases of disproportion may rest largely in the field of genetics.

The age at which the patient walked may give us a clue to rachitic changes in the pelvis. In the general physical examination, not only should outspoken curvatures of the spine be noted, but it should be remembered that even slight lumbar lordosis may be associated with anteroposterior shortening of the superior strait. The conformation of Michaelis' rhomboid is important. Flattening of this figure from above downward or from side to side is usually definitely associated with pelvic contraction. In the multiparous patient, much important information may be gained from the character of the earlier labors. However, such information must be carefully evaluated. The previous labors may not have been at term, or labor may have terminated without difficulty because of the subnormal weight of the full term fetus.

EXTERNAL AND INTERNAL PELVIMETRY

When we consider the information that is essential to determine the pelvic and fetal relationships, it becomes apparent at once that external pelvimetry is of value only as a guidepost to the true size of the maternal pelvis. It often fails in this function, so that at present we regard these external measurements only as adjuncts to other and better methods of investigation. The usual external pelvic measurements taken are the interspinous, intercristal, and external conjugate diameters. The importance of the first two has been overestimated. The relationship of the one to the other has been emphasized as of diagnostic significance in the presence of a rachitic pelvis, but it is certain that a rachitic pelvis may present the normal relationship of these two diameters. Furthermore, the length of the intercristal diameter cannot be taken as any indication as to the available transverse room at the superior strait.

It is true the shortening of these measurements and that of the external conjugate are usually present in generally contracted pelves, but it is equally true that a perfectly normal sized pelvic canal may exist in certain short statured, "light-boned" individuals whose external pelvic measurements are notably

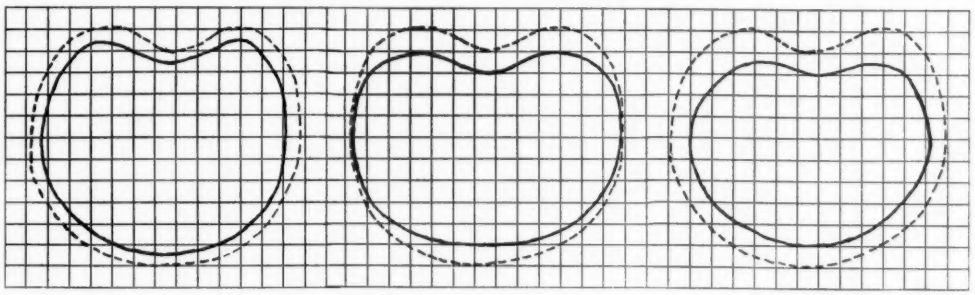


Fig. 1. Showing outline of superior strait in normal pelves, indicated by interrupted line, and the most usual types of contracted pelves, indicated by the black line. The normal pelvis measures, in the anteroposterior diameter, 10 centimeters; transverse diameter, 12.5. In A the generally contracted pelvis measures, anteroposterior diameter, 9 centimeters, transverse diameter, 10.74 to 11.25. In B, the simple flat pelvis, the anteroposterior diameter is 8 to 8.5, the transverse diameter is 12.5. In C, the general contracted flat pelvis, the anteroposterior diameter is 8 to 8.5, the transverse diameter is 10.75 to 11.25.

shortened. An example of this is shown in Figure 2, which is a pelvigram of a small white primipara, aged 23 years. The external measurements were: interspinal 22.0, intercristal 24.75, external conjugate 16.75. At the end of a 12½ hour labor, an easy forceps extraction of a 3,256 gram baby was performed. The roentgenogram shows a normal pelvic inlet: anteroposterior diameter, 11.25, transverse diameter, 12.5 centimeters.

Most men of experience will agree that the information gained from determining the length of the external conjugate diameter is not as important as was once supposed. In the first place, in the absence of a definite posterior bony landmark, the measurements of two observers may not agree within a centimeter of one another. Secondly, while marked shortening of this diameter is usually indicative of shortening of the anteroposterior diameter of the inlet, moderate degrees of such shortening of the external conjugate are difficult to evaluate. However, I feel that these external measurements should still be used in our routine examination, but that they should be thought of as guideposts only, and not regarded as criteria of the true condition at the superior strait.

The determination of the diagonal conjugate per vaginam, when it can be made, is an important and useful measure. I qualify this statement, since in certain individuals the sacral promontory cannot be reached because of the height and thickness of the symphysis pubis. In many nulliparous women, because of the rigidity and sensitiveness of the soft parts, the method cannot be used without an anæsthetic. For an examiner to state that his inability to reach the promontory by palpation is *prima facie* proof of an adequate anteroposterior diameter of the superior strait is, of course, ridiculous. Furthermore, the transverse diameter of this plane cannot be even approximated by this method. Nevertheless, a reasonable effort should be made to measure the diagonal conjugate, always remembering that there may be an error of at least 0.5 centimeter in calculating the true conjugate. With regard to determining the pelvic inclination, I agree with Williams (15), who states: "Except when markedly abnormal, the pelvic inclination possesses no practical obstetrical significance, and is of value only in the study of atypical pelves and in anthropology."

OUTLET PELVIMETRY

In considering pelvimetry of the inferior strait, it may be said that serious disproportion seldom results from outlet contraction unassociated with contraction at the inlet. The importance of measuring the outlet, however, should not be minimized. The funnel pelvis and its relation to perineal laceration and the arrest of labor must be recognized. Fortunately, the landmarks used

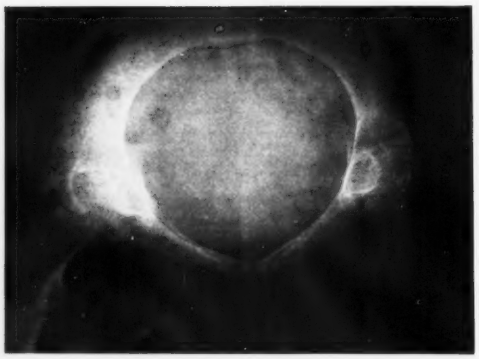


Fig. 2. Pelvigram of primipara with small external measurements. The anteroposterior diameter measures 11.25 centimeters, the transverse, 12.5 centimeters.

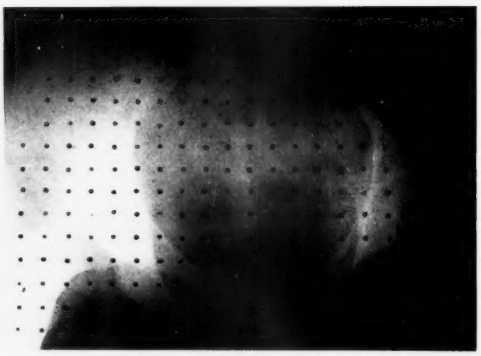


Fig. 4. Roentgenogram of "small round" pelvis. The anteroposterior diameter measures 9.75, the transverse, 10.5.

for measuring the outlet are readily recognized, and outlet pelvimetry is quite satisfactory for determining the essential diameters of that plane. The instrument which we have found of value is the outlet pelvimeter, which I described in 1915 (10).

SUMMARY OF EXTERNAL PELVIMETRY

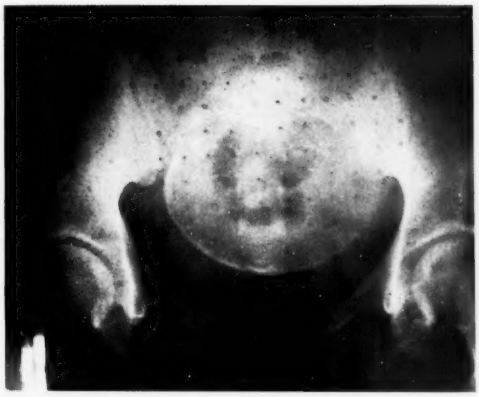
In general, then, the procedures noted are usually employed for determining the size of the maternal pelvis. With regard to those methods pertaining to the superior strait, I think it must be concluded that for the most part they are not only inadequate but often misleading. It would appear that if we are to gain more accurate knowledge of this important pelvic plane, other methods must be employed, and it seems beyond doubt that such methods must have a roentgenographic basis. This idea has become greatly reinforced in my mind since surveying the results with roentgen pelvimetry in this clinic—an experience now extending over 8 years.

By means of the roentgenologic methods that we are now employing, we are able to perform two important maneuvers: first, to measure accurately both the anteroposterior and transverse diameters of the superior strait; and second, by means of lateral pelvigrams, to outline the relationship of the promontory and anterior surface of the sacrum to the posterior surface of the symphysis pubis. This latter procedure is particularly useful in a patient in whom a rachitic pelvis is suspected. Furthermore, in patients at term it gives an excellent idea of the relationship of the presenting part to the pelvic brim.

Fig. 3. Perforated lead sheet. Perforations exactly 1 centimeter apart.

ROENTGEN PELVIMETRY

I do not propose in this communication to go into the exact details of our technique for roentgen pelvimetry. I would refer those interested to my two latest publications (8, 11) on the subject. I will, however, outline briefly the methods. In pelvimetry of the superior strait, the patient is placed in the semi-recumbent position on the table, with the tube 30 to 36 inches above the plate. The superior strait is made as nearly horizontal as is consistent with the comfort of the patient. The level of the superior strait is established



Figs. 5 and 6. Roentgenograms showing fetal head *in utero* at term. Occipitofrontal diameter readily measured and outline of cranium easily demonstrated.

by means of calipers. The distances between the top of the symphysis and the top of the table, and between the depression beneath the fourth lumbar spine and the top of the table are then measured. The tube is centered as nearly as possible over the center of the superior strait. In general, this point is 5 centimeters posterior to the upper border of the symphysis. A suitable exposure is made and the patient is removed from the table—the tube and exposed plate *remaining in position*. A lead sheet (Fig. 3) with perforations exactly 1 centimeter apart is now introduced in the same plane as that previously occupied by the superior strait, and a flash exposure made *on the same plate*. Development of the plate reveals the outline of the superior strait and the exposed dots. The space between each two dots equals a distance of 1 centimeter in the plane of the superior strait. Calculations are made directly on the film by counting the dots in the diameter to be measured (Fig. 4).

In making the lateral pelvigrams, the patient is placed laterally on the table and the tube centered over a point midway between the upper border of the symphysis pubis and the depression beneath the fourth lumbar spine. The centimeter perforated sheet may or may not be used. Generally, we do not employ it in connection with these lateral roentgenograms, since we prefer to measure the anteroposterior diameter by the previous method, which also makes available knowledge regarding the transverse diameter.

Of the two procedures outlined, roentgen pelvimetry of the superior strait is more frequently used. The lateral technique is employed only when a rachitic pelvis is suspected, or in certain cases in which there is failure of engagement in the first stage of labor. The importance of accurate mensuration of the transverse diameter of the superior strait is apparent when we consider the more usual types of contractions found in this plane. It is obvious that when shortening of the anteroposterior diameter occurs, compensation must be found in the transverse diameter, if the obstetrical compatibility of the fetus and pelvis is to be maintained. It would appear, therefore, that the length of this line shares in importance with that of the anteroposterior diameter. In a recent paper, I have attempted to emphasize this point, as determined by our roentgen method (12).

FETAL CEPHALOMETRY

The importance of fetal cephalometry is at once apparent in considering the problem of disproportion. While the methods usually employed in determining the maturity of the fetus and the size of the fetal head give us an

Fig. 7. Lateral roentgenogram at term. Principal points outlined to show relationship of fetal head to promontory and symphysis. No disproportion.

approximate idea of these important data, the roentgen technique promises to be of as great value in this connection as in pelvimetry.

At the end of the thirty-sixth week of a normal pregnancy, we expect the fetal head to be engaged in the pelvic brim. Lack of engagement generally depends upon one of three conditions: (1) A somewhat distended uterus containing a small fetus which does not require the additional pelvic space. (2) A relaxation of the abdominal walls in a multiparous patient. (3) Disproportion between the fetal head and the superior strait. Therefore, if proper treatment is to be afforded, those cases in which engagement does not occur during the last month of pregnancy require frequent observation and supervision.

One of the principal signs of probable disproportion seen in primiparous women is the abnormal projection of the abdominal wall as term is approached. In multiparous women, owing to the abdominal relaxation which is usually present, this sign is not of the same significance. However, if present in either group, the underlying cause should be determined. The relation of the head to the pelvis may be tested by the method of Kerr (5). In this procedure, the external hand grips the head, as suggested by Pawlik, and pushes it into the pelvis, while two fingers of the left hand introduced into the vagina determine the relation between the pelvis and the head. The thumb of the "internal" hand may be utilized in palpating along the brim, in order to estimate the degree of overlapping of the fetal head. This procedure may be employed without anæsthesia, but greater accuracy is insured if anæsthesia is used.

Mueller's well known procedure consists essentially in having an assistant force the head down into the inlet, while the examining fingers determine the degree of descent into the pelvis. Such methods often give us valuable information, but, on the other hand, no knowledge of the real size of the fetal head or of the extent to which it may be molded. With regard to determining the size of the fetal head through the thickness of the abdomen, the methods of Perret (7) and McDonald (6) may be mentioned, but they have not proved to be valuable for the reason that the thickness of the abdominal wall cannot be accurately determined.

We have been impressed in our investigations (13) by the uniformity with which the unengaged fetal head rests in the lower abdomen, with the occiput directed transversely to the right or to the left. Even when the head is dipping, we find that the deviation of the occiput anteriorly or posteriorly makes but little difference in our measurements. We believe, therefore, that in any patient in whom the position of the brow and occiput can be determined by abdominal palpation, the plane of the occipitofrontal diameter can be established and accurate measurements obtained by roentgenography.

Not only can the occipitofrontal diameter be immediately read from the developed plate, but it is possible also to reconstruct the outline of the fetal cranium in its true proportions (Figs. 5 and 6). In subsequent studies, we propose to make use of this fact to determine the effect of labor on molding of the fetal head.

We have found that the length of the biparietal diameter is satisfactorily determined on the basis of its ratio to the length of the known occipitofrontal diameter. In order to establish this ratio, we studied the measurements of 149 fetal heads which had *not been subjected to molding*. In this series, 76 were born by uncomplicated breech extraction and 73 by elective cæsarean section. In 80 per cent of these cases in which the length

Fig. 8. Pelvic roentgenogram at term. Showing possibility of pelvic mensuration even at end of pregnancy. Small round pelvis. The anteroposterior diameter measures 9.5, the transverse, 10.75.

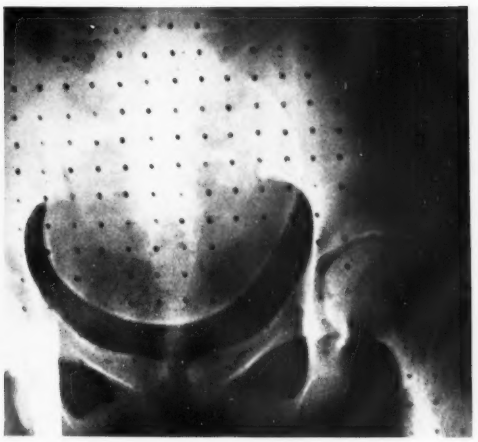


Fig. 9. Roentgenogram of same case as in Figure 8 for cephalometry *in utero*. Occipitofrontal diameter, 10.5, biparietal diameter, 9.0.

of the occipitofrontal diameter measured between 10.5 and 12.5 centimeters, the length of the biparietal diameter measured from 9 to 10 centimeters. In studying the entire group, we were surprised to find that this ratio was remarkably constant. For instance, in 56 of our cases with an occipitofrontal diameter of 12 centimeters or over, the average length of the biparietal diameter was 10 centimeters. In 85 with an occipitofrontal diameter above 10 centimeters but below 12 centimeters, the average biparietal diameter was 9.0 centimeters.

From these relations, we have constructed the following table:

Given an occipitofrontal diameter of	subtract for biparietal
12.5	2.5
12.0	2.5
11.5	2.0
11.0	1.75
10.5	1.5
10.0	1.5
9.0	1.5

We have checked figures in a number of cases which we have been able to study before and after cæsarean section, and have thus far found them to be remarkably accurate.

FETAL MATURITY

Authorities agree that the best index to fetal age is the fetal length, or crown-heel distance—a measurement which it is difficult to determine in certain patients with thick abdominal walls, or those with hydramnios. The determination of the length of the occipitofrontal diameter may furnish valuable data bearing on this question, for we have found that this length bears a definite relationship to the length of the fetus. From our data, it would appear that an intra-uterine occipitofrontal diameter of 11.5 or over signifies a safely mature fetus, while a measurement of 11.0 indicates that the fetus is but slightly, if at all, premature. A diameter below 10.5 centimeters in length would appear to indicate unquestionably that the fetus is premature (14).

LATERAL PELVIGRAMS

We have already spoken of obtaining the lateral pelvic roentgenogram. This procedure is extremely useful in cases of suspected disproportion, because the direct relationship of the fetal head to the anteroposterior diameter of the inlet may be determined (Fig. 7). It is also of value in determining the exact descent of the fetal head in those patients who are undergoing a test of labor. I have previously pointed out (9) the value of lateral pelvigrams in the diagnosis of rachitic pelves.

In a discussion of disproportion, two other important factors must be considered. These

are the force of the uterine contractions and the ability of the fetal head to become molded. With respect to the latter, we cannot say at this time just how adaptable the fetal head may become, but we know that excessive molding causes excessive cranial stress, resulting in overstretching and tearing of the tentorium cerebelli and falx cerebri. In this connection, Ehrenfest (2) and Holland (4) have shown that the long delay in expulsion of the head resulting from disproportion leads to marked hyperemization of certain parts of the brain, with exaggerated anæmization of other parts. Therefore, where the outcome is questionable because of the existence of disproportion, we should not overvalue the ability of the head to become molded.

SUMMARY

In the foregoing, the methods used in this clinic for determining disproportion between the fetus and the maternal pelvis are summarized. These methods are not all used routinely in the examination of pregnant women, nor are they all used in all cases of suspected disproportion. The methods are adapted to the individual case. The interpretation of the findings is judged in the light of clinical experience. Our results show one thing to be certain—in doubtful cases, much of the guesswork of former years is eliminated. The methods may be used at all stages of pregnancy, and even in the first stage of labor (Figs. 8 and 9). The apparatus and technique are extremely simple. It is the writer's opinion that the time has arrived when to treat doubtful cases of disproportion without proper roentgenological examination is as culpable as to treat fractures without the aid of the same diagnostic means. If these methods prove as valuable as they now seem to be, it is likely that in the future, in addition to the methods now in common use, roentgen mensuration of the pelvis will be carried out in all primiparous patients.

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CLINICAL SURGERY

FROM THE SURGICAL DEPARTMENT OF THE UNIVERSITY OF NEBRASKA

TECHNIQUE OF SUBTOTAL THYROIDECTOMY

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THE results to be aimed at in subtotal thyroidectomy are: First, to furnish an ordeal which is neither painful nor nerve racking to the patient; second, an operation performed under such conditions that when a toxic state of the thyroid is present postoperative thyroid storm will not occur; third, the removal of sufficient gland substance to avoid recurrence of hyperthyroidism and not enough to cause hypothyroidism; and fourth (and in the opinion of the patient by no means the least) a good cosmetic result with minimal scar. The results to be avoided, which may be grouped under the most frequent complications, are: first, secondary hæmorrhage; second, changes in the voice following operation; and third, postoperative tetany due to destruction or removal of the parathyroid bodies.

The pre-operative preparation of the patient is best carried on in conjunction with an internist in order that the proper time for operation in serious cases may be determined by consultation and one individual does not have to make the decision. In this way undue enthusiasm on the part of the surgeon and undue conservatism on the part of the internist may be curbed and a conclusion reached which will be of more benefit to the patient.

As an immediate pre-operative preparation the patient is given 30 grains of sodium bromide the night before the operation. An hour and a half before operation morphine sulphate, $\frac{1}{8}$ grain, and scopolamine, $\frac{1}{150}$ grain, are given hypodermically and then Fischer's solution, 6 ounces, at body temperature, containing glucose 5 per cent and sodium bromide, 60 grains, are injected slowly high in the rectum by gravity through a small catheter. Three-quarters of an hour before operation another dose of the same amount of morphine and scopolamine are given hypodermically and by the time for removal to the operating room the patient is usually asleep and the journey is accomplished without disturbance of this sleep.

In another communication I have given the reasons why it is my opinion that cervical paravertebral anæsthesia prevents cardiac storm during and after operation, and this type of anæsthesia is now employed in all my personal cases. It is interesting to note that though the patient may be disturbed somewhat during the injection of one side of the neck, by the time the upper injections are made on the opposite side the patient once more passes into a quiet dreamy condition or even one of actual sleep.

Placing the patient in position with head thrown back, preparation of the skin with picric acid 5 per cent in 80 per cent alcohol, draping the field and changing of gloves and gown by the operator occupies sufficient time for the anæsthetic to take effect and operation can be begun immediately.

A curved collar incision having a slight concavity upward and having its center about 1 inch above the episternal notch is made. When the neck returns to its normal position, this will be found to lie in such a position that in women it will be covered by a string of small beads. It is important that the upward curve of the incision at either end where it overlaps the edge of the sternomastoid muscle by about an inch be very slight as otherwise the scar at this point will be visible. The incision is carried downward through the platysma throughout its entire length until the vessels passing up and down over the pretracheal muscles and the muscles themselves, including the inner portions of the sternomastoids are uncovered. It is important that any sizeable bleeding points in the subcutaneous tissue be clamped and ligated at this time. If this is not done now, it may be neglected later and bleeding from the small vessels, particularly those over the episternal notch and in the angles of the wound may give rise to secondary hæmorrhage which, though not necessarily dangerous, nevertheless results in considerable oozing which is alarming to the patient.

The upper flap is dissected upward as far as the thyroid cartilage and the underlying muscles are well exposed. The lower flap is also dissected free

Fig. 1. Skin flaps turned back, pretracheal muscles clamped, divided, and retracted by spring retractors. Compress covering flaps is not shown.

from the underlying structures for about half an inch in order to give it a small amount of play and allow suturing to be done later with more ease and more accurate apposition of the platysma muscles and skin. The anterior jugular veins are now clearly seen lying on the surface of the pretracheal muscles and act as guides between which a longitudinal incision is made to separate these muscles in the median line from the level of the notch of the thyroid cartilage above to the episternal notch below. The edge of the sternohyoid muscle is lifted up and the sternothyroid is seen beneath it. It is freed in turn by dividing the fascia along its inner margin by sharp dissection and then sweeping the finger beneath it following the line of cleavage between it and the thyroid gland until the muscle is freed from the gland from the upper to the lower pole. This is done on each side and the care with which it is done makes for ease in delivery of the gland; for it is surprising how a few fibers of this muscle covering the thyroid will hinder the subsequent steps of the procedure. With the finger passed beneath the ribbon muscles holding them forward, two clamps are placed transversely on either side and the muscles are divided between them. Warm moist compresses are now placed over the skin flaps and hooked spring forceps are placed in the muscles to give a good exposure of the gland (Fig. 1).

The next step in the procedure is of extreme importance and is one to which little attention has

Fig. 2. Clamps have been placed on the suspensory ligament.

been directed. Many years ago Kocher noted the fact that the superior laryngeal nerve might be injured during ligation of the upper pole of the thyroid gland and more recently Dilworth, New, Mullin, Berlin and Lahey, and Nordland have shown that the superior or external laryngeal nerves, contrary to the usual teaching of the textbooks, supply not only the cricothyroid muscles with motor fibers but also furnish motor innervation to the interarytenoid muscle. If, therefore, during ligation of the upper pole of a high lying thyroid, the superior laryngeal nerve be injured it is possible that voice changes may result through loss of function of the cricothyroid or interarytenoid muscles. The external branch of the superior laryngeal nerve lies on the outer surface of the thyroid cartilage and the cricothyroid muscle covered by, and closely in contact with, the inner surface of the superior pole of the thyroid. When ligating the superior pole it may best be avoided as follows: The upper margin of the thyroid isthmus and the inner margins of the upper poles are held in close contact with the cricoid cartilage and cricothyroid muscles by a band of fascia, the suspensory ligament of the thyroid, which passes downward from the thyrohyoid membrane and thyroid cartilage, and represents the remnants of the embryonal stalk of the thyroid gland. In some cases it contains the so called middle lobe of the thyroid. It also contains internal branches of the superior thyroid artery which anastomose in front of the cricoid cartilage, and this anastomosis sends branches downward to the isthmus and inner portions of the lateral lobes (Fig. 1). The first step in thyroidectomy, after exposure of the gland, is the division of the suspensory ligament between clamps and ligation of the stumps (Fig. 2). If a middle lobe is present it is also clamped and ligated with the ligament. Thus there is left a small portion of normal thyroid

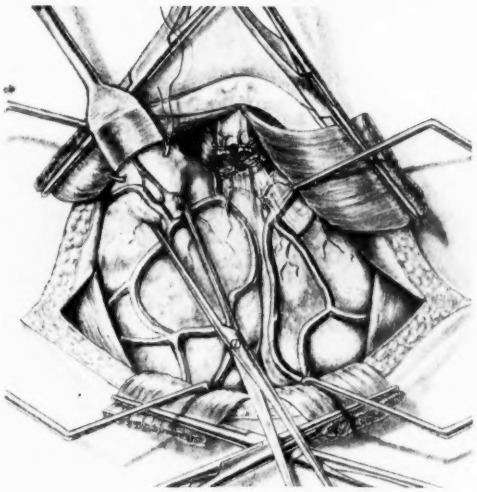

Fig. 3. The suspensory ligament has been divided and ligated. The upper pole is grasped with a forceps and drawn forward and outward away from the larynx while the upper pole is ligated.

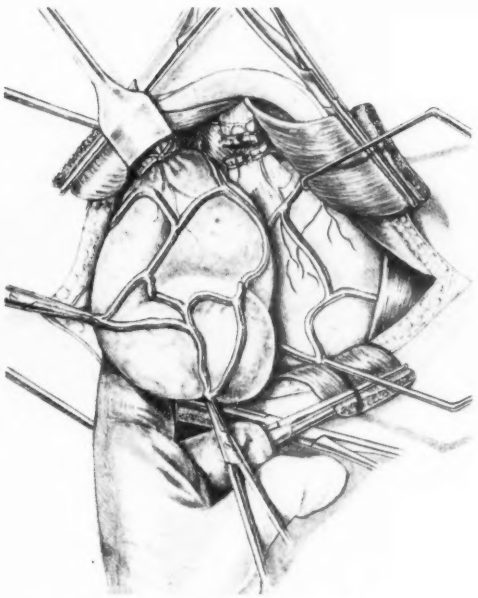

Fig. 4. The upper pole has been ligated and the lower pole is being elevated with the finger.

which practically never becomes diseased. The isthmus and upper poles are now free from the larynx and can be drawn forward and outward and the upper poles ligated with No. 1 chromic catgut with no danger to the superior laryngeal nerve (Fig. 3). The ligature is passed through the tissue of the thyroid and includes the superior thyroid vessels, thus constituting a mass ligation of the upper poles. I have practised this for many years and it has also been recommended by Gustav Schwyzer who believes that the healthiest tissue is found in the upper pole of the gland and that ligation *en masse* preserves it. It is, however, well to examine the upper poles carefully and if any small adenomata are present the ligature should be placed above them so they may be removed with the remainder of the thyroid mass.

The upper poles being ligated, the fingers are passed along the lateral margins of the gland and the middle veins are clamped and divided, as recommended by Hertzler. The finger then sweeps downward around the lower lobe which is delivered from its bed and brought up into the wound (Fig. 4). The inferior thyroid veins are then clamped well toward the posterior surface of the gland.

This procedure having been carried out on both sides the line of division of the thyroid is now well mapped out by the ligature above and the clamps on the veins below. With the finger behind the gland, the upper pole is divided and the incision is carried downward in front of the clamps (Fig. 5). The vessels are clamped within the gland as they are reached and the finger behind the posterior capsule serves two purposes. The clamping forceps can be prevented from grasping the capsule and endangering the recurrent nerve and parathyroids and the sense of touch tells the operator how much thyroid tissue he is leaving attached to the capsule and only a thin layer of tissue should be left. During this procedure an assistant rolls the gland over toward the midline and as the trachea is approached the incision moves toward an anterior plane in order to leave a triangular piece of thyroid in front and lateral to the recurrent nerve.

During this part of the operation, the patient is aroused and made to speak as each clamp is applied and before any further incision is made in order to make sure the recurrent nerve is not caught in a clamp or pressed upon.

The lower and lateral branches of the inferior thyroid artery are easily caught by clamps but the smaller branches which run in an anteroposterior direction between the inner surface of the lateral lobe and the lateral surface of the trachea are more difficult to catch and if not well clamped before being divided may retract and

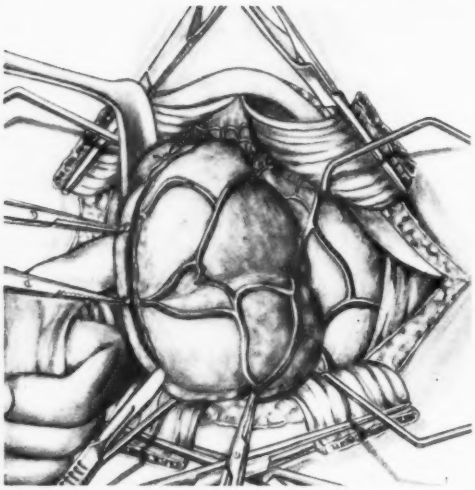

Fig. 5. The line of section of the gland is mapped out and the incision through the capsule is being made.

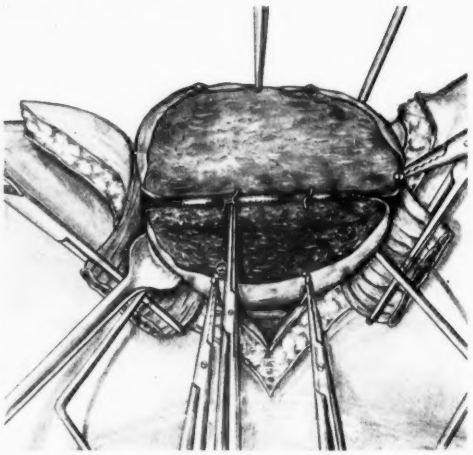

Fig. 6. The small vessels along the inner margin of the lobe are appearing and are clamped as they are encountered.

give rise to unpleasant bleeding which may take some time to check and the recurrent nerve may be endangered during the procedure. If the lobe is rolled well over toward the opposite side and the depth of the incision carefully watched these vessels will be found to come into view as the trachea is neared and can be clamped at this time (Fig. 6). While speaking of clamping vessels it is well to remember that the jaws of clamps should always be closed in a direction parallel to the course of the recurrent laryngeal nerve, that is from above downward, and never in a direction at right angles to it. The small vessels being divided the trachea is reached at a point halfway between its posterior and anterior limits and the isthmus is separated from it leaving the layer of fascia covering the trachea intact. When the procedure outlined has been carried out on both sides about five-sixths of the entire gland is removed leaving a small piece of gland attached to each upper pole and a thin shell attached to the posterior capsule in the angle between trachea and œsophagus. The vessels are now ligated with No. 1 plain catgut and the clamps are removed, when the stumps fall backward into the depths of the wound. If the clamping and ligating of vessels has been done carefully and not too much thyroid tissue has been included in the clamps and ligatures, a mass suture of the raw surface of the gland to control oozing is unnecessary. If there is no oozing I believe a suture of this type is better omitted for the insertion of a needle between trachea and stump of gland may endanger the recurrent laryngeal nerve by either including it in the ligature or striking and wounding it with the needle; or by traction upon it which dislocates it forward as the inner leaf of the capsule covering the stump is drawn forward and outward to meet the outer leaf when the suture is tightened.

Before the closure of the muscles, the drains are inserted. These are small gauze wicks which are passed between the sternal and clavicular heads of the sternomastoid muscle on either side and emerge near the lateral angles of the wound as suggested by Lahey. They prevent the occurrence of the dimple and adhesion which sometimes follow midline drainage. By the time this stage is reached, the anæsthesia of the muscles may have worn off and it is wise to inject 2 or 3 cubic centimeters of 1 per cent novocain solution into the sternomastoid before making the pathway for the drain. This should be made with a pointed hæmostat (Kelly type) and never with a sharp instrument because there may be an aberrant vein lying at this point and if divided it can cause very troublesome hæmorrhage. When the forceps has passed through the muscle the drain is grasped and drawn through from within outward and its inner portion is laid over the stump of the thyroid. Drains are removed on the third or fourth day.

The patient's head is now raised and the divided edges of the pretracheal muscles are sutured with a lock stitch of No. 1. chromic catgut. As these are inserted, locked loops are passed around the anterior jugular veins above and below the line of

muscle section. When the muscle clamps are removed these vessels do not bleed at once but it is important to remember that they may open up later and cause troublesome hæmorrhage if not securely ligated. The internal edges of the pretracheal muscles are now sutured throughout the whole length of their separation with No. 1 chromic catgut.

Sensation has now returned partially to the skin and its edges should be anæsthetized by subcutaneous injection of 1 per cent novocain solution introduced from within outward so the injection will not be felt by the patient. The skin and platysma are now approximated by a "dermal" suture which is introduced by passing it first through the entire thickness of the flaps and next through the skin only, the next passes through full thickness and the next through skin only and so on (Fig. 7). The approximation of both deep and superficial tissues by this method is accurate, insertion of a separate row of absorbable sutures for the platysma is avoided, and the resulting scar is a thin line in which the stitch holes do not show if the suture is removed before the fifth day.

A dressing of vaseline gauze covered by plain gauze is held in place by an adhesive strap which passes behind the neck, where it is covered to prevent sticking, crosses over the dressing in front, and the two ends applied to the chest above the breasts. The patient is then returned to bed where hypodermoclysis of 1000 cubic centimeters of normal saline solution is started immediately.

Fig. 7. Showing method of inserting suture in skin and platysma and site of insertion of drains.

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FROM THE STATE UNIVERSITY, KASAN, U. S. S. R.

A RADICAL OPERATION FOR CARCINOMA OF THE TONGUE

PROF. P. M. KRASSIN, KASAN, U. S. S. R.

OF THE malignant growths of the tongue, cancer is the most frequently found, although, fortunately, such growths are rare. The main features of cancer of the tongue are: the rapid development of the growth, the early appearance of metastases to the neck, and the rare involvement of the internal organs.

According to Woelfler, cancer of the tongue may be present in latent form for some time and then quickly develop and spread. Only through a radical operation in the early stage of the disease can the patient be saved.

The simplest method of procedure is removal of the growth through the mouth. This natural access, however, does not afford the surgeon sufficient freedom of manipulation even when accessory incisions are made. Consequently, preliminary operations were devised to assure better access to the tongue. The best known of these methods was resection which was used by such prominent surgeons as Langenbeck, Bergmann, Kocher, and Kroenlein. Bergmann's method is the one generally used. However, as this method has several disadvantages, I have devised a procedure which I began using some time ago and have modified until I believe that it now offers the best known method of removing cancer of the tongue, especially when it is difficult to reach the growth, i.e., when the cancer is at the base of the tongue.

The important points in the technique may be stated briefly as follows:

1. Proper exposure of the field to permit dealing with the metastases to the neck, for it is necessary to remove the cellular tissue as well as both the lymphatic and salivary glands of the regions involved, i.e., of the submaxillary region and the carotid.
2. Proper incision to permit exposure of the tongue.
3. Radical removal of the growth on the tongue itself.
4. Reconstruction of the wound.

It is essential if the operation is to be a success that the indications for the operation be carefully studied, that the patient be prepared with due attention, that the method of anæsthesia be carefully determined, that the operation itself be performed with skill, and last but not least, that the patient be given careful postoperative attention. Inasmuch as cancer of the tongue very seldom affects the tip and that, as a rule, metastases are found to involve not only the submaxillary regions, but to spread as well along the lymphatic glands over the region of the carotid artery and particularly of the jugular vein generally reaching as far as the dorsal part of digastric muscle, I suggest that the radical operation for cancer of the tongue be carried out along the following lines:

The incision through the skin should proceed along the median border of the sternocleidomastoid muscle on the side of the growth. The principal resecting incision is immediately traced, beginning at the terminal point of the skin which is in the region of the median border of the sternocleidomastoid muscle two finger breadths below the cornu majus of the hyoid bone. The incision is then extended upward to the base of the lower jaw to the anterior margin of the masseter muscle from which point it is drawn down to form a blunt angle open below along the lateral margin of the mylohyoid muscle and to stop at a distance of some millimeters before reaching the tuberculum mentale. The line of incision is then turned at a blunt angle, open upward, is extended to the mentali protuberance, directly to be turned down to form a sharp angle, open downward, and is drawn down to the tuberculum mentale on the opposite side. It is now passed further along the lateral border of the mylohyoid muscle to a point lying near the median border of the sternocleidomastoid muscle on the opposite side. The skin flaps, outlined by the first incision, are retracted on both sides thus leaving a wide, open space between them. After the incision of the aponeurosis, the cellular tissue and lymphatic glands in the region of the carotid artery and jugular vein are dissected, as well as both submaxillary salivary glands along with the cellular tissue and the lymphatic ganglions.

No preliminary ligation of the artery is done before the operation.

While the cellular tissue and the submental glands are being removed, the borders of the skin wound are turned aside from the top of the triangle and the cutaneous covering of the latter is entirely turned down. All of the cellular tissue

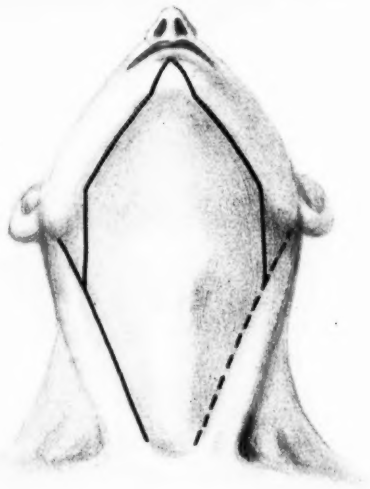

Fig. 1. Incisions outlined.

of this region and part of the aponeurosis are removed. When hæmorrhage is stopped we begin the preliminary partial osteoplastic resection of the lower jaw as follows:

The periosteum is divided on the front part of the chin by means of two incisions made in the direction of the skin wound and meeting at the mental protuberance. It is then turned off to the sides along the soft tissues. Now the mental foramina are carefully laid open so as not to injure the mental nerves. In the area of the triangular bone plate of the mental region, with the mental protuberance at the top and the mental foramina on either side of it either a triangular piece of bone, base downward, is sawed out by means of a circular file and electrical motor or there is outlined for temporary dissection a semi-oval area of bone together with the attachments of the chin muscles. On both sides of the triangle of bone two holes are drilled for the bone suture.

The soft tissues are next detached from the dorsal part of the jaw (mylohyoid muscle) on both sides and the mucosa of the bottom of the mouth is incised downward to the angles of the arc of the jaw, the dissection being controlled by a finger placed in the mouth. Great care should be taken not to damage the muscular attachment to the spina mentalis and adjacent parts. The triangular piece of bone is now completely sawed out from the region of the chin. The top of the flap is turned down and through the opening in the bone the periosteum and mucosa are incised. The flap, caught up with a pair of forceps at the top, is drawn downward, and simultaneously the bottom of the mouth cavity is lowered and the tongue is passed through the wound, thus giving free access on all sides. In the removal of a malignant growth of the tongue care should be taken to dissect even into the healthy tissue and, if necessary, part of the bottom of the oral cavity or arcus palatoglossus should also be removed. The latter step of operation is done with the knife and scissors. Bleeding is carefully controlled and the wound of the tongue is sutured.

The flap, which consists of all the soft parts of the bottom of the mouth together with the piece of bone from the chin region at the top, is replaced in its former position and is held fixed by means of a thin copper wire which is drawn through the holes previously drilled in the bone.

The skin wound is not completely sutured but openings which communicate with the oral cavity are left under the chin at double finger width. Through these openings an equal number of iodoform pads and sterilized gauze are inserted into the oral cavity. Soft dressings are applied.

For 2 days (48 hours) the patient is not given any food by mouth. On the third day and after, the patient is fed through a catheter (though not *à demeure*). The wound is frequently dressed, sometimes as often as twice a day. In addition to mechanical cleansing, the mouth is rinsed with a solution of rivanol; hydrogenium hyperoxidatum is also used.

The skin sutures may be removed on the seventh to eighth day after operation. The patient is kept in the hospital until the wound is completely healed (about 3 weeks).

I have recently operated on 5 patients affected with cancer of the tongue. Their histories contain nothing unusual so I will restrict myself to but brief accounts of them. I regret to say that two of the patients died, but death could not be attributed to the operation itself. One patient was a rather exhausted and thin individual who was an alcoholic and in addition suffered from catarrh of the apex of the lungs. This patient died on the eleventh day after operation. He had recovered sufficiently to be able to get out of bed and to walk about. Chloroform narcosis was used and preliminary ligation of the artery of the tongue had been done in this case. The technique of resection was unsatisfactory (I used the Gigli saw). The patient presented the picture of marginal numbness of the tongue wound, an aggravation of the septic process in the oral

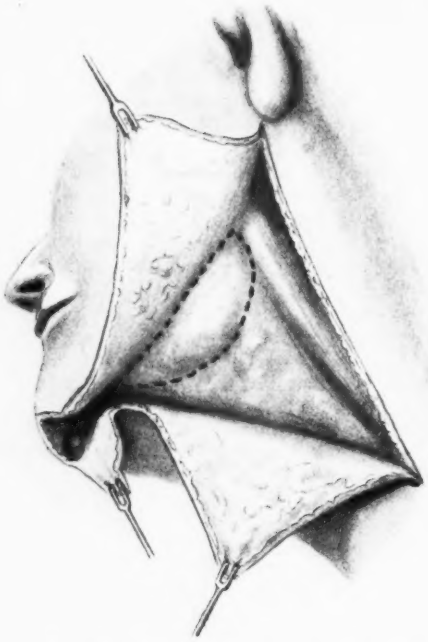

Fig. 2. Skin flaps retracted and semi-oval area of bone outlined for temporary dissection.

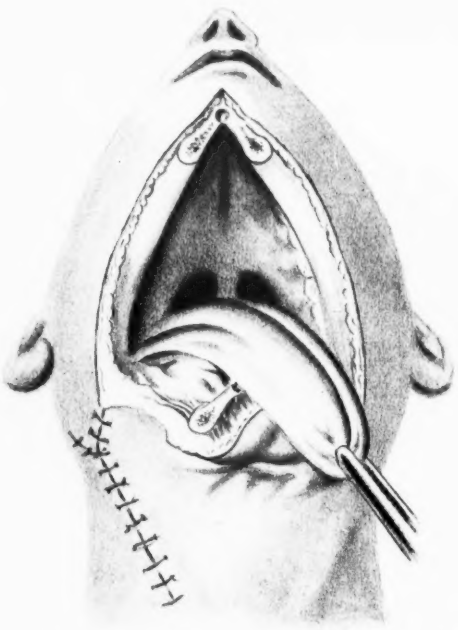

Fig. 3. Tongue pulled through wound. Illustrates wide field of operation.

cavity and eventually death was caused by heart failure through intoxication.

The second patient died from aspirational pneumonia. In this case also operation was done under chloroform anæsthesia and preliminary ligation of the tongue artery had been done previous to the removal of the growth. On the second day after operation the temperature reached 39.5 degrees, pulmonary symptoms developed, and the patient died.

The other patients made uneventful recoveries and left the clinic in a short time looking somewhat improved. In 2 of the cases I used local regional anæsthesia—80 to 90 centimeters of a ½ per cent novocain solution. The anæsthesia was complete. Briefly, the method was as follows: The novocain solution was injected into the nerve endings of the cervical plexus at the dorsal margin of the sternocleidomastoid muscle. The retromolar trigonem, and the alveolar and lingual nerves were blocked through the mouth and the solution was injected along the skin wound at the lateral margin of the mylohyoid muscles and under the mucosa of the bottom of the oral cavity in the region of the mental nerves as well as into the tissue of the tongue. In the last patient ether anæsthesia was used.

Objections have been raised to the use of the infiltration method with novocain solution in cancerous growths, but the use of chloroform has been advocated. I believe that local anæsthesia is the better method and in the future I shall try to perfect the method, avoiding, however, the infiltration of the tissues in the immediate vicinity of the cancerous growth. Preliminary ligation of the lingual artery I do not believe is really needed; for if the artery is tied off, it may give rise to the sensation of numbness of the stump of the tongue.

In conclusion, I wish to state that my method has been successfully used in the clinic of Professor Rasumowski (at Saratov) on 2 patients. Furthermore, Dr. Bodroff informed me at the last Congress of Russian Surgeons at Moscow that Professor Kolubakin had tried it in 2 of his cases, 1 of which was successful.

The method described has already been used in 9 cases, in 6 of which recovery was uneventful and the patients have fair promise for the near future.

CLINICAL APPLICATIONS OF BLADDER TUMOR PATHOLOGY[1]

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TUMORS of the urinary bladder present a frequent and a difficult problem to the urologist. This is evidenced by the ever growing series of cases reported from the larger clinics both in this country and abroad. The ultimate object of analyzing groups of these cases is to determine the results of the various forms of therapy employed, whether they be physical and chemical agents, surgery, or combinations of the two. For the individual patient one aims to be guided by the deductions from such analyses in deciding what plan of treatment offers the best chance of cure. When we discuss the modes of therapy at our disposal we understand each other reasonably well. When we attempt, however, to indicate the nature of the disease process from which the patient is suffering, we are sometimes on common ground but frequently we are far apart and seem to be conversing in foreign tongues. The cause of this misunderstanding is due in a measure to the complexity of the underlying pathological problem but in much greater degree to the inaccurate and divergent terminology employed in the classification of the lesions not only by clinicians, but by pathologists as well. That serious confusion exists is apparent, for one observes a frequent discrepancy between the urologist's and the pathologist's interpretation of the individual patient's malady. Thus in some series of cases the former has included in the carcinoma group, patients upon whose removed tumor tissue the pathologist of the same clinic has reported papilloma.

Now this bespeaks a certain lack of confidence on the part of the clinician in his colleague's interpretation of the histology of the tumor. Although many urologists admit, as Geraghty did, their inability to differentiate benign and malignant papillary growths by cystoscopic inspection, they nevertheless choose to dispense with the biopsy, the court of appeal in the case of doubtful tumors elsewhere in the body. They prefer to be guided by a therapeutic test, the mode of response to fulguration—electrodesiccation with the Oudin current, or electrocoagulation with the d'Arsonval current—(6, 7, 8).

A shroud of mystery seems to invest the subject of bladder tumors. The following factors appear responsible for their being regarded as something apart from the neoplasms of the rest of the human body, not amenable to the usual classifications, nor to the usual modes of diagnosis and treatment.

1. In the earlier days of open suprapubic operation, the removal of a seemingly innocent papillary tumor, histologically benign, was frequently followed by the subsequent development of similar tumors in the bladder and at times even in the drainage tract or postoperative scar. This was regarded as evidence of malignancy, and it was maintained that all papillary bladder tumors were carcinomatous, a view propounded years previously by Rokitansky and opposed by Virchow.

2. Patients with multiple papillary tumors, frequently small and sessile (papillomatosis), may subsequently have frank carcinoma of the bladder, or may develop metastatic phenomena and run a malignant clinical course (Buerger).

3. Rare cases of papilloma of the bladder have been described, the cells of which show no appreciable variation in type or arrangement from those of the ordinary papilloma. And yet the villi infiltrate the bladder wall beneath the tumor penetrating even into the perivesical fat. Buerger reported one such and designated it as an infiltrating papilloma but correctly classified it with the papillary carcinomata. Geraghty related a somewhat similar case.

4. The introduction and retention of the term malignant papilloma in the literature of the subject has been one of the most potent factors in the misunderstandings which prevail. It appears in the classifications of Geraghty, Young, Stenius, Scholl, Christeller, MacKenzie, Scott and McKay, and others. By this term is usually meant papillary tumors the cells of which are partly or entirely atypical or anaplastic but show no evidence of infiltrating the stroma or base. These tumors correspond to the changed papilloma of Buerger which he rightly included among the papillary carcinomata in the final classification of his material.

5. The next factor is a corollary to the preceding, namely that only such tumors are usually classified as papillary carcinomata which present infiltration of the bladder wall (e.g., Geraghty, Stenius, Christeller, MacKenzie).

6. The most recent addition to the sources of confusion is the classification of bladder tumors without reference to their gross pathology, their situation, extent, or invasive character. The basis

[1]A briefer report of this study appeared in the *Journal of the American Medical Association*, 1928, xci, 1697. Slight discrepancies are due to the obtaining of additional follow up data and some minor errors in the statistical tabulations. Presented at a stated meeting of the New York Academy of Medicine, March 6, 1930.

TABLE I A.—CLASSIFICATION OF VESICAL NEOPLASMS

1. Primary epithelial tumors—
   - A. Papillary (fibro-epithelial) tumors
     - Papilloma (benign)
     - Papillary carcinoma (malignant)
       - Non-infiltrating
       - Infiltrating
   - B. Non-papillary (flat) epithelial tumors
     - Adenoma (benign) { Solid / Cystic
     - Carcinoma (malignant)
2. Primary mesoblastic tumors—
   - A. Benign
   - B. Malignant (sarcoma)
3. Embryonal tumors—
4. Secondary tumors—
   - A. By extension, e.g., from prostate, cervix, rectum
   - B. By implantation, e.g., from kidney pelvis or ureter
   - C. By metastasis

TABLE I B.—THE COMMON VARIETIES OF VESICAL NEOPLASMS ACCORDING TO THEIR GROSS AND MICROSCOPIC CHARACTERS

1. Papilloma (benign)—cell uniformity and typism—
   - Pedunculated { Single / Multiple
   - Sessile — Papillomatosis
2. Papillary carcinoma—
   - Non-infiltrating { 2a. Scattered areas of somewhat atypical cells / 2b. More diffuse and more marked atypism
   - Infiltrating { Cells of benign type (rare) 2c / Cells anaplastic (atypical) { 2d. Stroma or stalk invasion / 2e. Submucosal base invasion / 2f. Muscularis and perivesical invasion
3. Non-papillary (flat) carcinoma—
   - a. Fibro-(scirrhus)
   - b. Medullary (transitional cell)
   - c. Adeno { from von Brunn's glands / from urachus
   - d. Squamous
   - e. Hornifying

of this system rests primarily on the proportion of undifferentiated (unripe) cells to differentiated (ripe) cells in the given neoplasm. All bladder tumors are looked upon as potentially malignant by those who employ this classification, e.g., Broders and Bumpus. The propensity for massive growth is regarded as sufficient to consider them so. This would seem a reversion to the views of Rokitansky.

If one now considers neoplastic processes in other parts of the body it becomes evident that analogous factors are encountered though not with the same frequency which obtains in the field of vesical neoplasms, nor is the same interpretation put upon them. (1) Thus the occurrence of multiple warts or condylomata on opposed skin surfaces in such a way as to suggest contact lesions or implants, is not considered a sign of malignancy. The epithelial inclusion cysts occurring after puncture wounds of the skin (by hypodermic or suture needles) are not regarded as malignant, although they may become so occasionally. (2) The occurrence of multiple neurofibromata in Von Recklinghausen's disease is likewise not so classified although sarcomatous changes may occur rarely in them. Gastric or colonic polyposis may exist for years and is considered benign although carcinoma may develop from one or more of the lesions. (3) Connective tissue growths made up of cells indistinguishable from fibroblasts, but not delimited by a capsule and invading the surrounding subcutaneous structures, are called fibrosarcomata because of this invasive property alone. A thyroid tumor may metastasize to bone, neither primary nor secondary growth showing histological features of malignancy, yet these tumors are classified with malignant neoplasms. The adenoma malignum, or destruens, of the uterus lacks, in its cells and structure, the microscopic earmarks of malignancy but it is grouped with the adenocarcinomas because of its properties of infiltrating the muscularis and metastasizing. (4) If a tumor of the uterine endometrium presents only the cellular changes of malignancy without evidence of infiltrating the muscularis one does not hesitate to label it adenocarcinoma. The term malignant adenoma would be a misnomer in such a case, something very different being connoted thereby as has just been pointed out. (5) In malignant tumors in general one recognizes that a stage of development exists in which the lesion is superficial, yet they are not excluded from the carcinomata on this basis. (6) The invasive character of a tumor has long been relied upon as an indication of its grave nature. Malignancy is not solely recognizable by cellular changes. Invasion and metastasis are also reliable indications, be the cells ever so innocent in appearance.

There is need, therefore, of a classification of vesical neoplasm which will serve the pathologist by its accord with the general principles of tumor pathology and terminology, and will meet the requirements of the clinician because it takes cognizance of gross as well as microscopic criteria. Such is, I believe, the following classification based upon the literature, and upon the material of the Mount Sinai Hospital available for study since 1911 (Table I A).

The common varieties of primary vesical tumors (Table I B) are papilloma, papillary carci-

Fig. 1. Specimen taken for biopsy from a case of multiple papillomata of the bladder. ×45.

Fig. 2. Part of resected bladder wall bearing sessile type of papilloma. Shows multiple stalks of origin and fusion of the villi. No invasion of stroma or base. ×12.

noma, and non-papillary carcinoma. This simple yet adequate classification was used by the late Dr. F. S. Mandlebaum in his beautifully illustrated contribution of 1907 (10). In this study of 37 cases he confirmed the belief that papillary carcinoma may be primary, or may develop from a pre-existing benign papilloma. Buerger, of the same laboratories, in a series of 113 cases, made a more detailed report of the histological criteria upon which the diagnosis of "changed papilloma" could be based (3). The changes he found occurred not only in the deeper parts of the growth, but in those portions accessible to cystoscopic removal of tissue for diagnosis. Of 52 cases of carcinoma 13, or 25 per cent, fell into this category and presented various stages of the transformation. Upon the basis of his observations it became more and more customary for the urologist to remove fragments of tumor tissue for microscopic study and to be guided in a considerable measure thereby in meeting the therapeutic problem which each case presented.

TECHNIQUE OF THE BIOPSY

While fragments of tumor tissue may be recovered in washings of the bladder, a much more

Fig. 3. Biopsy specimen from a case of "Adenopapilloma." ×36.

Fig. 4. Biopsy. Multiple small papillomata. Shows œdema and inflammation of stroma, cystic degenerative changes in epithelium. ×45.

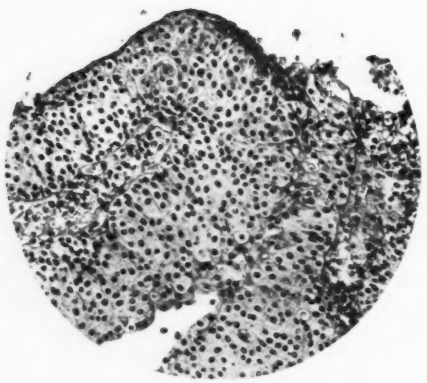

Fig. 5. Biopsy from a sessile papilloma. Same case as Figure 2. Shows the well defined limiting cell membranes. ×120.

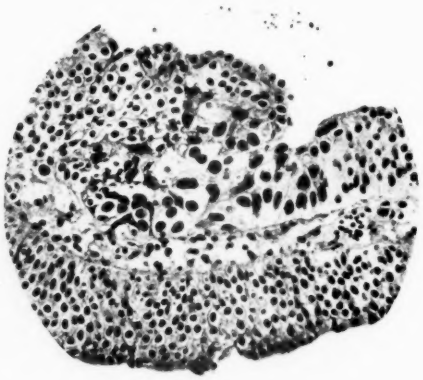

Fig. 6. Biopsy from huge papillary tumor. Showing papilloma architecture but areas of large atypical cells the importance of which was not recognized. Operative specimen papillary carcinoma (type 2a). Case 2. ×165.

certain method is their cystoscopic removal by means of the rongeur forceps or Young's cystoscopic rongeur, or the snare. The simplest method is the rongeur forceps applied through the operating cystoscope. If a single tumor is present fragments should be removed from several parts of the mass, for the malignant changes may be confined to a limited area. Especially should more solid looking hæmorrhagic or necrotic areas be investigated. If several tumors present themselves a biopsy should be performed on as many as feasible, particularly those which lack the typical fluffy villous character of the benign papilloma. If the mucosa about the base is nodular in appearance this site should be attacked. If the tumor is flat and its central portion necrotic or ulcerated the forceps should be applied to the viable periphery of the neoplasm.

In many instances the operator has sent to the laboratory bits of tissue which adhered to the fulgurating electrode. While information may be derived from such material I have observed that

Fig. 7. Biopsy from base of papilloma, showing inflamed stalk and remnants of viable investing epithelium. July, 1914. Case 8. ×45.

Fig. 8. Biopsy specimen of one of the tumors found in the bladder. November, 1918. Papilloma. Case 8. ×45.

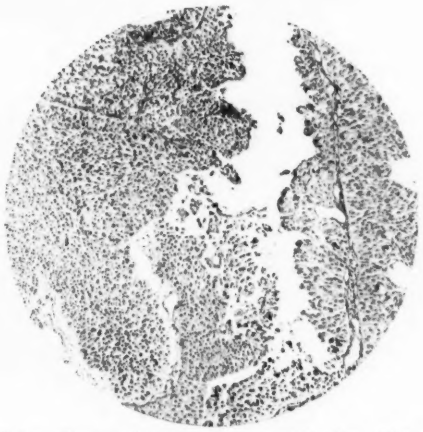

Fig. 9. Biopsy of recurrent tumor at fundus which did not respond to fulguration. Papillary carcinoma. Case 8.

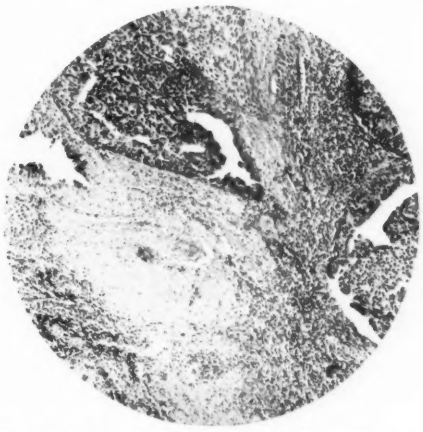

Fig. 10. A section of the resected tumor showing stroma and submucosal invasion (type 2e). Case 8. ×45.

such tissue frequently shows the effects of the coagulating current and is unsuitable for reliable histological study. Patients treated with electrocoagulating currents and then subjected to biopsy may present not only these disadvantages but also secondary inflammatory changes, necrosis, and incrustation which render the task of the pathologist more arduous. I would urge, therefore, that the operator remove the tissue for diagnosis and then apply his electrode to the tumor. This procedure will minimize bleeding and will seal off the traumatized area. Thorough irrigation to remove liberated cells should follow.

In the cases of benign papillomata which respond to endovesical therapy the urologist should remove a specimen from the base of the tumor as soon as this becomes visible, or from the resulting ulcer of the bladder mucosa whence the tumor sprang. It is only in this way that the most treacherous but fortunately rare form of papillary carcinoma may be detected in time. I refer to the infiltrating tumors the cells of which, even if they invade the base, present no anaplasia, and differ in no detectable manner from those of the benign papillomata.

With the increasing use of the endotherm knife

Fig. 11. Biopsy of small papilloma appearing in the bladder vault, three years after resection of papillary carcinoma. Case 8. ×45.

Fig. 12. Biopsy of pedunculated papillary carcinoma (type 2a). Fulguration, dissemination. Died of infiltrating papillary carcinoma 22 months later. Case 12. ×75.

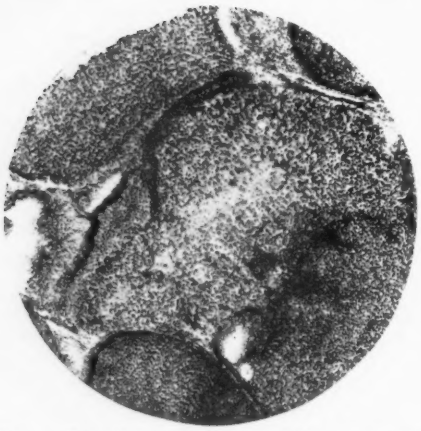

Fig. 13. Operative specimen. Area of tumor presenting atypical cells and mitoses. Papillary carcinoma (type 2a). Case 13. ×45.

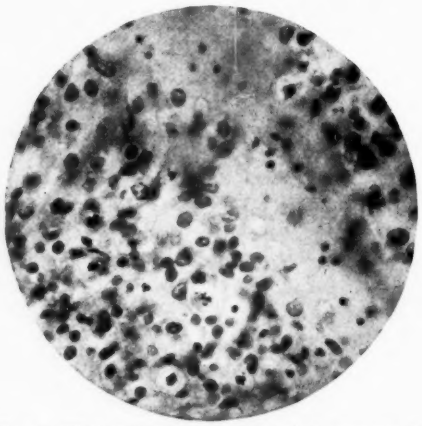

Fig. 14. High power photomicrograph of same specimen as is shown in Figure 13. Case 13. ×180.

and surgical diathermy, the study of resected tumor bearing areas of the bladder wall has also been rendered less satisfactory because of the effects of the current upon the tissues. While this is disconcerting to the pathologist, it is evidence of the rationale of the newer methods employed in attacking the problem of malignancy.

The fixed tissue method of study has been adhered to in this laboratory because we have been unwilling to submit the valuable specimen obtained through the cystoscope to the hazards of frozen section work, because a permanent preparation is highly desirable as a matter of record, and because rapid methods make a report within 24 hours regularly attainable. The single hæmatoxylin stain is very satisfactory and personally I prefer it to the double hæmatoxylin eosin stain. When necrosis or inflammation is present, iron hæmatoxylin will often bring out nuclear details which are not secured otherwise. The van Gieson stain is of value in determining the question of infiltration of the bladder musculature.

I have reviewed the slides of every tumor submitted to biopsy or operation at the Mount Sinai

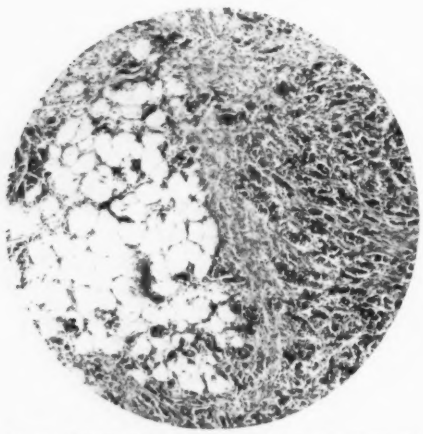

Fig. 15. Metastatic carcinoma of the omentum, which developed 2 years after operation on the bladder. Case 13. ×45.

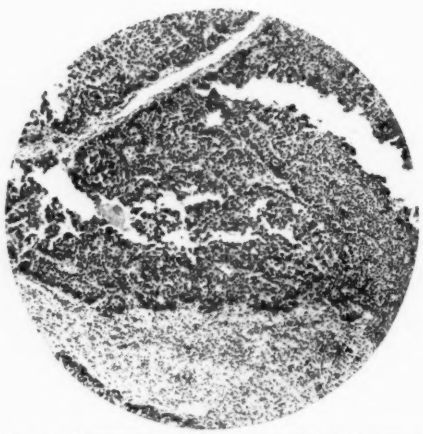

Fig. 16. Biopsy of papillary tumor which did not yield to fulguration. August 9, 1917. Papillary carcinoma (type 2a). Case 14. ×45.

Hospital since 1911 and have diagnosed each in accordance with the classification outlined. The clinical information and subsequent course of the patient were obtained from the data made available by the late results recently compiled by Dr. Beer and his associates. There were two objectives of the study; first, an evaluation of the biopsy for diagnosis, second, an evaluation of the pathology for prognosis. In several instances my diagnosis differed from the one originally rendered, probably because the criteria for benign papilloma have become progressively more strict, and because I have learned to attach greater importance to slight cell changes which formerly were either overlooked or their significance underestimated.

PAPILLOMA

The ordinary variety of papilloma is a soft, shaggy, villous tumor springing from the bladder mucosa by a well defined pedicle. A delicate connective tissue core continuous with the submucosa of the bladder and containing blood vessels forms the skeleton. Surrounding the core and its delicate branches is an investment of epithelium continuous with the epithelium of the bladder mucosa. The cells are arranged in a radial palisade manner at right angles to the core, demarcated from its stroma by a well defined basement membrane (Fig. 1). The epithelium may be few or many layers deep. As the tumor grows, adjacent villi fuse. The fusion may go on to produce an almost solid epithelial tumor with little stroma.

A number of stalks growing simultaneously from the bladder wall and fusing as they grow produce a broad based sessile type of growth, the villi of which are short and rounded (Fig. 2). Another form of sessile papilloma appears to be derived by proliferation of the cells lining the glands of von Brunn and these may be designated as adenopapillomata (Fig. 3). Ulceration, necrosis, and incrustation occur in papillomata rarely, and then usually after treatment.

The cells of the tumor present a high degree of uniformity in size and shape. The nuclei are elongated, elliptical, stain rather uniformly, and may show mitosis in the deeper layers of actively growing tumors. The cytoplasm of the cells is poorly demarcated from that of its neighbor. The surface cells may show hydropic degeneration if the growth is subject to trauma by the sphincter vesicæ. Inflammatory changes in the stroma may be marked as the result of infection (Fig. 4). The basement membrane, however, remains intact and tumor cells do not invade the stalk. In the solid sessile tumors there is a tendency for the limiting cell membranes to be more prominent and for mitoses to be more frequent (Fig. 5).

In Table II, I have summarized 90 cases of papillomata diagnosed on biopsy and confirmed by response to high frequency treatment, operative specimen, and late results. New tumors or recurrences occurred in 23 per cent of these patients, but they too were benign and responded to high frequency treatment, and in one case to resection.

CASES ILLUSTRATING DIAGNOSIS, TREATMENT, AND COURSE OF PAPILLOMATA OF THE BLADDER

Mrs. A. F. had a large, sessile, papillary tumor. Two biopsies showed typical papilloma. The growth was destroyed after several treatments with monopolar current. Cystoscopic control 4 years later showed no recurrence.

D. H. had a small, pedunculated, papillary tumor. Biopsy examination showed papilloma. Growth was readily destroyed with the high frequency current. In third year a few small mucosal elevations were noted and destroyed. Patient was cystoscopically well 4 years.

A. I. had a small papilloma, confirmed by biopsy, which was cured by fulguration. Cystoscopy, 10 years later, showed no recurrence.

H. K. had a large, pedunculated papilloma. Diagnosis was controlled by biopsy. Patient cured by fulguration and remained well for 2 years as shown by cystoscopic control. In third year a new papilloma was discovered arising from the sphincter margin. At operation the papilloma was excised and base was destroyed by surgical diathermy. Pathological examination showed papilloma.

M. M., man aged 60 years, had suffered from hæmaturia 5 years. Papillary and solid growth occupied the right wall of the bladder and extended down almost to the bladder neck. Areas of necrosis and ulceration were noted. Clinical diagnosis was carcinoma. Five specimens punched out from different parts of growth showed papilloma. At

TABLE II.—PAPILLOMA BIOPSY REPORTS CONFIRMED

Number of tumors in bladder		Confirmed by early cystoscopic control	Confirmed by operative specimen	Confirmed by cystoscopic control (1 to 15 yrs.)	Confirmed by late letter control	New tumors or recurrences, benign only, 23 per cent
Single		29	6	26	1	12
Pedunculated, large	26					
Pedunculated, small	25					
Sessile	5					
Total	56					
Multiple		14	4	9		7
Pedunculated, large	7					
Pedunculated, small	16					
Sessile	2					
Total	25					
Papillomatosis 9 cases		1	5	5	2 1 autopsy, 5 yrs. after cure	2

operation a growth the size of a peach was resected with full thickness of the bladder wall. On examination it was found to be a solid sessile papilloma with no atypism or infiltration. Control cystoscopy, 2 years later, showed no evidence of recurrence.

Dr. M. presented a small papilloma which was corroborated by pathological examination. Patient was cured by endovesical fulguration. Cystoscopy 4 years later showed no recurrence. Cystostomy was done for prostatic obstructing adenoma. No evidence of recurrence was found. Patient died of bilateral renal infection.

J. S., a man of 60 years, was treated successfully by fulguration for a large papilloma, which was confirmed by three biopsies. Patient was readmitted to hospital 4 years later for hæmaturia due to bleeding from a prostatic adenoma. Cystoscopy showed no recurrence of vesical tumor. He now presented an epithelioma on the dorsum of the right foot.

S. S., a man, presented a large papilloma which was proved by biopsy and destroyed by high frequency in 1920. Small recurrences at the original site required treatment at intervals for 2 years thereafter. Three years after the last recurrence the bladder was free of any vestige of tumor.

I. B. was treated in the out patient department for several small tumors at the base of the bladder. Biopsy showed papilloma. Fulguration caused necrosis of the tumors but left areas of incrusted cystitis which finally necessitated curettage through a cystotomy wound. In spite of this treatment incrustation recurred and the patient was lost from observation.

K. C., a man of 59 years, came under our observation in 1921. Nine years before that a bladder tumor had been removed by a general surgeon at another hospital. Five days ago hæmaturia had recurred for the first time. He presented papillary tumors on the anterior wall, the fundus, and about the sphincter. Two biopsies showed papilloma. His treatment was sporadic and the development of other tumors occurred. In 1926, he consented to open operation and by means of the endotherm knife, a half dozen large papillomata were excised with the mucosa surrounding their bases. The pathological examination showed remarkable uniformity of structure, no evidence of malignancy or infiltration. On the twelfth day after operation patient died of pulmonary embolism. As his history stated that hæmaturia preceded his first operation by 7 years, he apparently had papillomata of the bladder for a period of 21 years without developing malignant changes.

A. K., a man of 62 years, had a benign pedunculated papilloma removed surgically in 1920. Small scattered growths recurred soon thereafter and then were treated by fulguration by the operator before the patient came to our clinic. He presented small papillomata about the right ureteral orifice on the posterior wall and in the scar at the fundus of the bladder. Several specimens were removed and were reported papilloma (Fig. 4). The tumors were gradually destroyed by fulguration in the course of 10 months. In 1927, 4 years after his last treatment, he died of other causes at the Montefiore Hospital. An autopsy performed there showed no tumors in the bladder. However, the mucosa was thickened and presented numerous cystitis cystica lesions. This case presents papillomatosis following surgical (cutting) removal of a single papilloma.

B. S., a man of 56 years, was admitted to Mount Sinai Hospital, in 1916, for frequency and dysuria. In 1913 he had been operated upon at another hospital for a tumor of the bladder. He now presented a ring of papillomata encircling the sphincter and papillary tumor buds at the site of the scar in the fundus. A typical extraperitoneal exploration of the bladder was made and a condition of papillomatosis found and dealt with by thorough Paquelin cauterization. No pathological examination was made at this time. Cystoscopic control carried out for 4 years showed no recurrence.

In 1923, however, he again came under observation for hæmaturia and presented a large sessile papilloma occupying a great part of the right lateral wall. A biopsy showed no evidence of malignancy, but it was deemed advisable to carry out a resection of the tumor bearing area. The operative specimen was a broad based, sessile papilloma, the cells of which, while larger than usual, showed remarkable uniformity, no atypism, and no infiltrating tendencies (Figs. 2 and 5).

In 1924 because of recurring suprapubic extravasation infection and fistula formation, an opportunity to explore the bladder was offered and no recurrence was found. A perineal prostatectomy for fibro-adenoma of the lateral lobes accomplished healing of the fistula. A cystogram taken later showed distortion of the bladder resulting from the resection, and bilateral vesicorenal reflux. Cystoscopic examination 3 years after the resection showed no recurrence. The patient is symptomatically well at the present time but attacks of pyelonephritis due to reflux caused by bladder irrigation or cystoscopic examination have made further investigation inadvisable.

This case illustrates again the long course which patients with papilloma of the bladder may present. He began with a single tumor—a single large tumor for which a successful resection was carried out—developed papillomatosis, and after this was cured. For 15 years he has been fortunate enough to escape malignancy.

PAPILLOMA REPORTS PROVED INCORRECT

In 7 additional cases the original pathological report of papilloma made upon specimens removed either through the cystoscope or at open operation was proved incorrect by subsequent events.

CASE 1. R. C. had a single large papillary tumor of the bladder. A few small fragments removed through the cystoscope were diagnosed papilloma, June 6, 1914. Dr. Hyman reports that the tumor did not respond to fulguration and that the man died a year later with the evidences of spinal metastasis. On reviewing the biopsy specimen, large cells with large nuclei and mitotic figures were observed which suggested papillary carcinoma and should have led to a request for more material.

CASE 2. H. H., a man of 30 years, had a huge papillary tumor filling the bladder. Two adequate biopsies were made and a diagnosis of papilloma was rendered. The operative specimen consisted of a tumor about 10 centimeters in diameter arising by a broad base from the right lateral bladder wall. Although the histological picture was predominantly that of papilloma, scattered areas of large atypical and multinucleated cells were observed. The base was not infiltrated. The diagnosis was therefore papillary carcinoma (type 2a).

Reviewing the biopsy specimens similar atypical areas were now noted (Fig. 6) and the diagnosis should have been made upon this basis.

CASE 3. J. H. presented himself with a large papillary tumor of the bladder, biopsy of which showed a rather solid papilloma with marked inflammatory reaction. As the tumor failed to respond to fulguration, a second biopsy was made and again the diagnosis was papilloma. Opera-

tion revealed a villous tumor the size of an orange arising from the anterior wall of the bladder but attached also to the base of the bladder in the region of the right ureteral orifice. The anterior half of the bladder was resected, the attachment at the base of the bladder was cooked through with surgical diathermy, and radium emanation seeds were implanted in this area. Examination of the specimen showed invasion of the stalk and base of the tumor but presented only a few atypical areas in its depth. The tumor was therefore classified as papillary carcinoma (type 2d). The presence of these areas of atypical cells excluded it from the group of infiltrating tumors without atypism (type 2c). Careful review of the biopsy specimens disclosed no areas upon which the correct diagnosis could have been made, the atypical foci being confined to the depth of the neoplasm.

CASE 4. Joseph C. presented three fairly large tumors of the bladder. Fulguration was employed. Biopsy of only one tumor was made, and reported papilloma. Patient developed a fatal uræmia due to pyelitis. At postmortem examination two tumors, one in either paratrigonal region, proved to be papillomata. The third tumor, sessile, and posttrigonal in situation, proved to be an infiltrating carcinoma (type 2f) the cells of which showed but little atypism.

CASE 5. Jacob C., with history of difficulty in urination, stoppage, and hæmaturia for 5 years, was operated upon by a general surgeon (February 15, 1917) for prostatic obstruction, cystoscopy not having been done. Numerous papillomata were found and a specimen removed was reported to be a papilloma. A cautery destruction of the tumors was undertaken secondarily (March 6, 1917) and removed tumor tissue again was diagnosed papilloma. At a third operation soon afterward (March 16, 1917) a section of the bladder wall was submitted for examination. This showed infiltration of the muscularis and perivesical tissue by a papilloma type of growth. The diagnosis was therefore papillary carcinoma (type 2c).

CASE 6. H. L., admitted for profuse hæmaturia, presented on cystoscopy a large papillary tumor with broad base on the left lateral wall and numerous smaller growths near the vesical neck. Specimens removed with the cystoscopic forceps showed the histology of papilloma. Fulguration failing to control the hæmaturia the cautery operation recommended by Dr. Beer was resorted to. The large growth was excised with the cautery, the numerous smaller ones were destroyed *in situ*. Unfortunately, the large tumor was lost and therefore not examined. Cystoscopic examination before discharge showed a small recurrence on the left side of the bladder, which was thoroughly fulgurated. Several small buds had appeared behind the trigone and treatment of these was begun. Another biopsy was done and the report was papilloma.

Nine months later he was readmitted for pain, stiffness, and weakness of the right thigh. A tender prominence was noted in the region of the right os pubis and X-ray examination, which had been negative before operation, showed a destructive lesion. On cystoscopic examination a few small, sessile buds were seen at the fundus, biopsy of which was reported as papilloma. Nothing suggesting malignancy was found in the bladder at this time. A specimen removed from the pubic bone proved to be carcinoma of the transitional cell type.

Whether the large bladder tumor which was lost contained the source of this metastatic tumor remains unknown. The bladder showed no clinical evidence of local recurring malignancy. In the absence of an autopsy the case is not complete, but it is most probable that the large tumor, which unfortunately escaped examination, was a papillary carcinoma.

CASE 7. F. McL., a man of 33 years, had been under treatment at another city for a papillary tumor of the bladder. Although originally only the size of an acorn the tumor had spread despite six fulguration treatments. He now presented two large growths on the right side of the bladder, sessile and partly solid in appearance, surrounded by a zone of œdema. One was partly necrotic. A biopsy (January 27, 1922) was reported papilloma. High frequency therapy was therefore continued, the bladder being apparently free of tumor on April 13. A month later the right half of the bladder seemed œdematous, and a few flat growths in this area were treated. Six months later (October, 1922) a similar appearance was noted and a second biopsy was reported papilloma, hypertrophied inflamed mucosa, and submucosa.

On March 19, 1923, a number of papillary growths and œdema of the right bladder wall down to the vesical neck were observed. A third biopsy was done and the report was papilloma, but operation was deemed advisable. The mucosa of the involved area was found thick and velvety with three small flat growths. The Paquelin cautery was applied thoroughly. On September 30, 1923, cystoscopy revealed an intense cystitis, a few nodules at the vault, and a small calculus. The latter was crushed and evacuated.

On February 22, 1924, thickened tissue about the right ureteral orifice was punched out for examination and reported as papilloma by another pathologist. Fulguration was again undertaken. On July 12, 1926, the patient once more came under observation for a papillary growth on the right side of the bladder, and the report of the fifth biopsy in the case was papillary carcinoma. At operation the growth involved the right wall and bladder neck. Diathermy and radium were employed. A specimen excised at this time showed infiltrating papillary carcinoma (type 2f). The patient ceased 6 months thereafter.

The course of this case strongly suggests that the condition was a malignant one from the onset and that the repeated reports of papilloma upon the biopsy material misled the clinician. On reviewing the slides I found, in the very first biopsy, areas of atypical cells. The second biopsy showed nothing to suggest malignancy. The third and fourth biopsies were definitely carcinomatous with invasion of the stroma (type 2d). The final stage was that of infiltration of the muscularis. Three of the original pathological reports were incorrect, and undoubtedly contributed to inadequate treatment of the lesion in its earlier stages.

In reconsidering these cases, therefore, papillary carcinoma should have been suspected or definitely diagnosticated from tissue obtained cystoscopically in Cases 1, 2, and 7. In Case 3, the diagnosis could not be made from the superficial tumor tissue removed for biopsy. The operative specimen showed only a few deeply situated areas of atypical cells, but infiltration of the stroma and base definitely established the malignant nature of the growth. In Case 4, the bladder contained three tumors, two benign and one ma-

lignant. The biopsy specimen was probably derived from one of the benign tumors. Cases 5 and 6 illustrate the malignant course which papillomatosis may pursue. Infiltration of the bladder wall may not be detected even at operation. In Case 7, however, carcinoma should have been suspected at the first biopsy and definitely diagnosed at the third biopsy.

PAPILLOMA WITH SUBSEQUENT CARCINOMA

In 4 cases of papilloma diagnosed by biopsy and corroborated by other facts, carcinoma of the bladder developed later. Such instances add to the complexity of the subject.

CASE 8. S. C. was under observation since 1914. His history presents a remarkable sequence of events. In July, 1914, he first came to the out patient department for treatment of hæmaturia. A single papilloma of the bladder was found and treated by fulguration. When the growth had been destroyed down to its base a specimen from the latter was punched out for microscopic examination. It showed the inflamed connective tissue stalk covered in part by typical epithelium of benign papilloma type (Fig. 7).

The patient was free of symptoms but not controlled cystoscopically until November, 1918. At this time he returned to the clinic for frequency, dysuria, and terminal hæmaturia of 4 months' duration. He presented (1) a large papillary tumor hiding the right ureteral meatus from view; (2) two small growths in the midline behind the interureteric ridge; (3) a pedicled tumor arising about ½ inch above and lateral to the left ureteral meatus; (4) a larger tumor which seemed to arise from the right lateral wall further back in the bladder. There was no induration per rectum. Specimens removed from three of the tumors showed the histology of typical papilloma (Fig. 8).

High frequency treatment was begun, and the left lateral growth was burned off at its pedicle at the third sitting. Frequency, severe dysuria, and bleeding ensued, and induration above the left lobe of the prostate appeared. Pericystitis was diagnosed and open operation was decided upon.

At operation November 29, 1918, a small perforation of the bladder and local pericystitis were found and were undoubtedly the result of too vigorous d'Arsonval therapy. A large tumor on the right side with broad pedicle was excised through its base with the cautery. Several smaller growths were burned to a crisp *in situ*. The large tumor proved to be a papilloma. Control cystoscopy, July, 1919, showed no evidence of tumor.

On August 15, 1921, he returned for hæmaturia of 2 weeks' duration. Cystoscopy showed two papillary growths paratrigonal in situation, and a more solid sessile growth at the fundus. With fulguration the two former disappeared but the latter resisted the current, and a biopsy was therefore made. This was diagnosed papillary carcinoma (type 2b, Fig. 9).

On November 28, 1921, a resection of the fundal part of the bladder bearing the carcinoma was performed and the specimen confirmed the diagnosis. It showed, however, stroma and submucosal base invasion, with a tendency to squamous cell type of growth (2f, Fig. 10). This illustrated the fact that the biopsy, while indicating the malignant nature of the growth could not be relied upon to determine invasion of the bladder wall.

Control cystoscopy in 1922 and 1923 showed no evidence of recurrence. On October 21, 1924, however, a small papillary growth at the fundus was observed and was removed with the punch forceps. The base was then fulgurated. Microscopic examination showed it to be a benign papilloma (Fig. 11). This treatment was adequate, for three control cystoscopies have shown no recurrence.

To summarize, the patient presented the following order of events: 1914, single papilloma, biopsy, responded to high frequency; 1918, multiple papillomata, biopsy, confirmed by operative specimen; 1921, three tumors, two yielding to fulguration. Tumor at fundus which did not respond; biopsy diagnosis of papillary carcinoma, confirmed by operative specimen; 1924, small papilloma, biopsy, and cure by fulguration; 1928, free of recurrence, three cystoscopic controls.

CASE 9. A. H., a man of 33 years, was treated, in 1917, for a single papilloma of the bladder, by fulguration, biopsy having confirmed the clinical diagnosis. In 1920, hæmaturia recurred and cystoscopic examination showed a condition of papillomatosis. A biopsy was reported papilloma. At operation May 3, 1920, one large pedicled tumor was found on the right lateral wall and excised; numerous small growths scattered throughout the bladder were destroyed with the cautery. The operative material was also diagnosed papilloma. Recurrences were found cystoscopically in a few months. Because of a urinary fistula, which opened and closed, and the appearance of a growth at the fundus, a second operation was undertaken March 21, 1921. The sinus was excised but showed no growth. A large tumor on the anterior wall and smaller ones of the lateral walls were treated with cautery. Material removed for examination was again reported papilloma.

Postoperative recurrence a year later was treated by high frequency but a third operation August 13, 1923, became necessary. An infiltrating tumor of the posterior wall extending up to the sinus tract was implanted with radium emanation seeds. Tumor tissue obtained at this time showed a papillary carcinoma invading the submucosa at the base with small, dark staining cells. Having rendered the previous reports of papilloma myself the old slides were reviewed. The original biopsy material in 1917 unquestionably showed papilloma. The biopsy of 1920 showed on careful search an area of stroma invasion which had been overlooked, and the operative specimen showed invasion of the stalk in the tumor which had been excised. This also had been missed. The operative material of 1921 showed no tumor involvement of the sinus tract, but the bladder tumors showed areas of atypical cells and tumor cells in vascular and lymphatic spaces. The biopsy of a recurrent tumor in July, 1922, had been reported papilloma by another pathologist, and on reviewing this slide I again found stalk invasion. It is apparent that the importance of looking for stroma and stalk invasion had not been sufficiently impressed upon me at the time of the original examinations. The diagnosis of carcinoma should have been made in 1920 and in each instance thereafter.

Small recurrences in the bladder and posterior urethra occurred and were treated palliatively by fulguration. The right kidney had to be removed for pyonephrosis. X-ray therapy was employed, but the patient died in February, 1926, 9 years after the discovery of the first bladder tumor.

CASE 10. H. S., a man of 43 years, gave a history of hæmaturia at intervals for 6 months. Cystoscopy October, 1922, showed a small papilloma on the right margin of the sphincter and a large papillary tumor lateral to the left ureteral orifice. The pedicle seemed broad and the surface showed some incrustation. An adequate biopsy obtained from this tumor showed papilloma. Four treatments with d'Arsonval current caused complete disappearance of the lesions. A control cystoscopy 4 months later gave no

evidence of recurrence. The patient did not return for further examination until 5 years later (1927) when he observed blood in the urine.

A small, flat, papillary tumor mesial to, and above, the left ureteral orifice was found, and the d'Arsonval current was applied. A week later a flat necrotic ulcer was found at the site of the tumor with small papillary excrescences at the lateral margin. Specimens removed from this area showed inflamed bladder wall with downgrowing buds and epithelial inclusion nests and cysts, regarded as an inflammatory reaction phenomenon. A month later the fulgurated area was found healed but small nodules at the margin were again observed. Three weeks thereafter an ulcer had reappeared at the site of the tumor and the mucosa between this and the ureteral orifice was velvety and thickened. Specimens from the ulcer margin and the thickened mucosa showed papillary carcinoma.

Operation was performed subsequently by Dr. Squier, who found a resectable papillary carcinoma requiring a left ureteroneostomy. If a biopsy had been made at the time the new tumor was discovered, it is probable that its malignant nature would have been detected at once.

CASE 11. R. T., a man of 56 years, in 1916 had been treated by fulguration elsewhere for bladder tumor. Four years later (1920) hæmaturia recurred, for which he was treated at another hospital, and was then admitted to Mount Sinai Hospital. At cystoscopy an inflamed bladder with an elevated trigonal region was found as well as a small papillary growth on the trigone near the right ureter orifice. Examination per rectum disclosed considerable induration and enlargement of the prostate, so that the possibility of malignancy was seriously entertained. Biopsy of the bladder tumor, however, was reported papilloma. At operation the small growth was excised with the cautery and on examination proved to be a papilloma. In the prostate was an abscess which was drained and tissue removed from the abscess wall showed purulent inflammation. This explained the impression which the rectal examination had given.

Five years later (1925) the man returned to the hospital for recurrence of hæmaturia, dysuria, etc. He now presented an extensive, infiltrating, flat carcinoma involving the anterior wall of the bladder. The resected tumor was a scirrhus cancer (type 3a). The patient died 6 months later with metastases to the peritoneum, omentum, and inguinal nodes.

In Cases 8 and 11, it seems beyond reasonable doubt that the carcinomata developed in the bladder at a time and situation sufficiently remote from the original benign papilloma to establish their independent origin. In Case 10, although the first and second tumors occurred in the same part of the bladder, the interval of 5 years and the marked difference in their response to fulguration point to their independence. In Case 9, it is possible that the original tumor was one of early carcinoma although a careful review of the biopsy gives no evidence of it. It also responded to fulguration, whereas the later growths did not yield to such treatment and the microscopic examination confirmed their malignancy.

Of all the patients studied these four alone were afflicted originally with papilloma and subsequently with carcinoma. In one case only (Case 10) did the malignant growth arise at the site of the first (benign) tumor. In other instances in which this sequence seemed to have occurred (Cases 5, 6, 7, 12, 13, 20, 21), a review of the material proved either that minute changes of malignancy had been overlooked in the original biopsy or that the case was one of papillomatosis. On the contrary, patients with papilloma have been observed for 20 years without development of malignancy.

SOURCES OF ERROR IN BIOPSY DIAGNOSIS

From what has been said it is evident that a biopsy report of papilloma may be rendered by the pathologist in some cases of carcinoma of the bladder for the following reasons, unavoidable on his part.

1. Insufficient material, or improper material such as fulgurated tumor tissue.

2. In the rare cases of infiltrating tumors of benign cell type (group 2c), the diagnosis cannot be made unless tissue has been removed from the infiltrated base.

3. Co-existence of benign and malignant tumors in the same bladder, material from the benign lesion alone being submitted (as in Case 4).

4. The malignant cell changes may be confined to the depth of the tumor inaccessible to biopsy (Case 3). Contrary to general belief this is exceedingly rare.

5. Cases of papillomatosis in which it is evident that only a few of the numerous tumors are examined, and a malignant one may readily be missed (Cases 5 and 6).

PAPILLARY CARCINOMA

Of the three groups of common bladder tumors, the papillary carcinomata constitute the most numerous. Of 285 bladder tumors considered in this paper, 142, about 50 per cent, belong in this group. Ten of these have already been reported in some detail. Of the 142 papillary carcinomata, 26, or more than 19 per cent, were multiple tumors. The statement is frequently made that multiplicity speaks for benignancy. Of the benign tumors in this series, 38 per cent were multiple. Multiplicity was therefore only twice as common in benign as compared with malignant papillary growths.

For important practical purposes the non-infiltrating papillary carcinomata should be considered separately from the infiltrating papillary carcinomata. The former are usually indistinguishable cystoscopically or grossly from benign papillomata. They may be pedunculated or sessile, single or multiple. The cytological changes

which brand the tumor as malignant may be very slight and limited to a small part of the growth, or very marked and present throughout the growth. These changes are the presence of large cells with irregular deeply staining nuclei, cells with atypical mitoses, pyknotic nuclei or lobulated nuclei, intensification of cell membranes with tendency to squamous type, loss of palisade arrangement, loss of uniformity. The stroma is not invaded and the basement membrane is preserved.

Infiltrating tumors comprise two types. The first is characterized by a cell growth indistinguishable from that of benign papilloma, yet the tumor invades the pedicle, infiltrates the bladder wall and its vessels, and may produce distant metastases. This is the only bladder tumor to which the term "malignant papilloma" may be applied with justification. The second type presents all the cellular aberrations observed in the non-infiltrating tumors with a more marked tendency to squamous metaplasia. The tumors show invasion of the pedicle, the bladder wall, and perivesical tissues. Frequently the papillary portion of the growth almost completely disappears by necrosis and leaves the ulcerated infiltrated base with a few papillary excrescences at the edge.

BIOPSY DIAGNOSIS OF PAPILLARY CARCINOMA

In the examination of snippings of vesical tumors removed through the cystoscope for diagnosis, the pathologist should adopt the mental attitude of "Guilty until proved innocent." Every fragment available must be examined critically and leisurely, not when pressed for time. As experience grows larger and the opportunity to check up the diagnosis increases, one becomes more and more convinced of the significance of slight cellular irregularities, loss of palisade arrangement, tendency to squamous metaplasia, variations in size and shape of the nuclei, pyknosis, prominence of nucleoli, and atypical mitoses. Breaking through of the basement membrane, stroma infiltration by epithelial cells and their presence in the small blood vessels of the core, should always be searched for. If the base of the mucosa adjoining the pedicle has been reached by the ronguer forceps, submucous or even muscularis infiltration may be detected. In some instances, a positive diagnosis of malignancy cannot be made from the first biopsy but the pathologist should indicate the suspicion he entertains and request more material.

Tumors of the groups 2 a, b, c, and d are frequently indistinguishable from benign papilloma by cystoscopic inspection alone. The difficulty of diagnosticating tumors of type 2c, fortunately rare, has already been indicated. The occasional favorable response to high frequency treatment is no conclusive argument for the innocence of the tumor. The case records show how often it has misled the urologist and delayed his resort to biopsy and adequate treatment of the lesion. Of 30 cases in groups 2a and 2b, high frequency alone succeeded in only 4 cases. In all fairness it must be stated that except in patients very advanced in years or suffering from constitutional disorders, the biopsy diagnosis of carcinoma has been a signal for us to discontinue this treatment. On the other hand, 12 cases of papillary carcinoma treated by high frequency with apparently good immediate result suffered early recurrence at the same site or ulcerative lesions at the base, all of which were proved malignant by pathological examination. Very many cases came to the hospital after varying periods of futile and repeated fulgurations for tumors which could have been diagnosticated at the first examination had a biopsy been made.

It should be emphasized that microscopic evidence of infiltration is much more frequent in papillary carcinoma than is clinical evidence of infiltration obtained by cystoscopic inspection, bimanual palpation, or operative investigation. In 138 cases of papillary carcinoma, clinical indications of infiltration were present in about 50 per cent, but histological evidence of invasion was found in 108, or 78 per cent. If biopsy in a case of papillary tumor proves it to be carcinoma and surgery is decided upon, segmental resection of the entire thickness of the bladder wall and the underlying perivesical fat should be carried out even if clinical signs of infiltration are lacking.

ILLUSTRATIVE CASES OF PAPILLARY CARCINOMA

To clarify the description of the various forms of papillary carcinoma which present themselves to the clinician and the pathologist, and to emphasize the value and limitations of the biopsy, a number of cases are herewith briefly reported and photomicrographs of the material are presented.

CASE 12. A. W., a man of 51 years, with painless terminal hæmaturia, presented a pedunculated papillary tumor the size of a plum arising from the left lateral wall. The biopsy showed areas of typical papilloma structure and a more solid part (Fig. 12) made up of larger cells with well defined limiting membranes and nuclei of varying size and staining reaction. From this examination, a diagnosis of papillary carcinoma type 2a could be made. For a time fulguration seemed effective, but 6 months later

operation became necessary and multiple small tumors were found scattered over the mucosa and an infiltrating tumor was found at the base. As resection was out of the question, the cautery and radium were applied. A specimen removed from the tumor at the base showed an infiltrating papillary carcinoma (type 2f). The patient ceased 9 months thereafter. Dissemination as a result of fulguration seems most probable. The rapid course of the disease was surely not indicated by its histology.

CASE 13. R. G., a woman 48 years of age, was operated upon, in 1912, for a bladder tumor. It was described as a papillomatous tumor the size of a walnut, pedunculated, and situated near the left ureteral orifice. The tumor came away when gentle traction was applied to it. There was no evidence of infiltration. The site of attachment seems not to have been cauterized. Examination of the specimen showed a solid type of papillary growth with very little stroma. The cells were of benign type except for one area, which showed large irregular nuclei and atypical mitoses (Figs. 13 and 14). The tumor was therefore a papilloma which had developed into a papillary carcinoma, type 2a. A few months after the operation multiple small recurrences were observed in the bladder for which endovesical high frequency was employed apparently with good effect.

In 1914, 2 years after operation, she was readmitted for an abdominal mass which proved to be metastatic carcinoma in the omentum (Fig. 15). Cystoscopy at this time showed small papillary growths at the fundus of the bladder in the region of the previous cystotomy scar. No pathological examination of these was made. The subsequent course of the patient is not known.

CASE 14. H. S., a male of 54 years, who had a "polyp" of the bladder destroyed by high frequency treatment in 1908, returned for hæmaturia early in 1917. Two papillomata were seen on the left wall of the bladder and fulguration was begun without removal of a specimen. Despite regular and persistent treatment the result was not satisfactory. A biopsy made on August 9, 1917, was reported as papilloma with atypical cells, probably malignant. On examining this slide (Fig. 16) I made an unequivocal diagnosis of papillary carcinoma (type 2a).

At operation November 22, 1917, a pedunculated tumor was removed by clamping and cutting the pedicle and then cauterizing the site of origin with the Paquelin cautery. The specimen was a papillary carcinoma with invasion of the stroma and stalk (Fig. 17). Tumor cells were seen in a lymphatic space. Here again the biopsy gave no clue to the extent of the lesion but did show its malignancy.

Two years later biopsy of a recurrent growth (Fig. 18) again showed papillary carcinoma. Five months later a right nephrectomy for pyonephrosis and partial cystectomy were performed. Tumor was found in the suprapubic scar tissue. The muscularis of the resected bladder wall was infiltrated (Fig. 19). Bony metastases supervened before death of the patient. It is evident that the first operative intervention was inadequate and not planned in accordance with the knowledge of malignancy derived at biopsy.

CASE 15. M. H., a man of 61 years, operated upon for bladder tumor, presented a papillary growth the size of a large walnut springing by a narrow pedicle from the trigone near the urethral orifice. The surgeon excised the tumor through the mucosa about the pedicle. A sagittal section through the growth and its pedicle (Fig. 20) showed its architecture to be that of papilloma but the pedicle presented an area of submucosal infiltration (Fig. 21) by cells which were closely packed, with dark staining nuclei and were undoubtedly tumor cells. The neoplasm must therefore be classified as a papillary carcinoma, type 2c. Unfortunately the subsequent history of this patient is not known.

CASE 16. E. E., a man of 59 years, had hæmaturia 18 months and 3 weeks ago. On cystoscopic examination a papillary tumor, the size of a plum, arising from the left wall of the bladder and overhanging the left ureteral orifice was found. Some parts appeared more solid than others. No biopsy was made. At operation the growth was destroyed by surgical diathermy down to its base and the tumor area was resected and the lower end of the left ureter was removed. The proximal end of the ureter was re-implanted. Examination of the resected bladder wall (Fig. 22) showed remaining areas of viable papilloma tissue which had not been destroyed by diathermy. Islands of similar cells, not atypical in appearance, were found in the submucosa and in the more superficial part of the muscular coat. As to the structure of the main body of the neoplasm, nothing can be said as it was destroyed in the course of the operative intervention. From the material at hand the growth must be classified as papillary carcinoma, infiltrating, type 2c. The case is too recent to make any statement as to end-result. A cystoscopy 3 months after the resection showed no recurrence.

CASE 17. D. K., a man of 56 years, had hæmaturia 15 months ago. A urologist found a bladder tumor, which he treated by fulguration. Although hæmaturia did not recur, pain and frequency persisted. Cystoscopic examination now showed an œdematous tumefaction of the posterior bladder wall suggesting infiltrating carcinoma. Three specimens were removed from the right edge of the lesion and reported as bladder wall showing islands of infiltrating tumor cells, papillary carcinoma type 2d (Fig. 23).

At operation a large part of the right lateral and posterior wall of the bladder felt thickened, and was resected, although no definite tumor was seen. On careful examination in the laboratory a tiny growth 2 to 3 millimeters in diameter was detected at one edge of the inflamed bladder wall. This proved to be the pedicle of the neoplasm for which the patient had been treated (Fig. 24) and from which the biopsy specimen had fortunately been obtained. Columns and nests of small pyknotic tumor cells grew in the fibrous tissue of the pedicle.

CASE 18. I. Z., aged 45 years, had hæmaturia at intervals for 9 months. The prostate was considerably enlarged and firm but smooth. Cystoscopy showed a papillary growth arising from the right side of the bladder neck. Several fragments were removed for pathological examination. All but one presented the typical structure of papilloma. This one fragment (Fig. 25) was a frond, the covering epithelium of which was benign in appearance. The stroma, however, contained large numbers of irregular cells with nuclei of various sizes and shapes and staining reactions. The tumor was therefore a papillary carcinoma, type 2d. The patient soon thereafter developed a staphylococcus aureus sepsis and died. As no autopsy was obtained the extent of the infiltrative tendency of the tumor cannot be stated. The case illustrates the fact that all parts of the growth are not the same in structure or type and that adequate material must be secured.

CASE 19. J. K. had a papillary tumor arising from a broad base near the left ureteral orifice. A biopsy taken after fulguration had been instituted showed degenerated tumor tissue and more material was requested. The clinician, however, did not comply with this request because the growth yielded well to the treatment. It melted away rapidly leaving an ulcer at the site of its base. A biopsy taken from the edge of the lesion, 2 months after treatment had been started, showed submucosal invasion by tumor cells. The mucosa itself presented small atypical papillæ (Fig. 26).

At operation a superficial ulcer 2.5 by 3.5 centimeters was found with extensive perivesical induration and

TABLE III.—SUMMARY OF TWO HUNDRED EIGHTY-FIVE CASES STUDIED

Type of tumor Number of cases	Biopsy done	Biopsy errors	No treatment	Cystoscopic treatment*	Operative treatment	Operative treatment plus radium	Operative deaths	Deaths due to the disease	Deaths due to other causes	Recurrent or new tumors: Benign	Recurrent or new tumors: Malignant	Metastasis	Number cases followed—182	Number cases arrested	Percentage arrested
I. Papilloma Single 56 Multiple 25 Papillomatosis 10 — 91	90	0	0	71	23	0	3	0	4	22	1		60	48	80
II. Papillary carcinoma Non-infiltrating A. Single 9 Multiple 5 — 14	12	3	2	6	5	1	0	2	2	1	2	2 omentum spine	9	4	44
B. Single 14 Multiple 2 — 16	13	0	3	3	6	4	3	3	2	0			12	5	42
Infiltrating C. Single 4 Multiple 2 — 6	1	1			3	3	1			0	1–5 yrs.		2	0	0
D. Single 30 Multiple 4 — 34	29	1	0	6	13	6	1	11	2	1	6	4 bones lungs	21	2	10
E. Single 14 Multiple 3 — 17	12	1	1	2	11	5	0	5	1	1	1	2	12	6	50
F. Single 44 Multiple 7 — 51 138	42	4	10	7	26	10	7	19	4	0	7	5 {1 lung 2 bones	36	5	14
III. Non-papillary carcinoma A type 7 B type 6 C type 7 D type 20 E type 4 (Multiple 5) — 44	35	5	10	1	29	4	9	13	1	0	9 (3 in) (scar)	nodes 6 bones prostate	30	5	16
Cases 6, 7, 9, 10 4 cases primary prostatic carcinoma—1 myosarcoma; 1 carcinoma in scar after operation elsewhere; 1 adenoma; 1 fibroma	4 4	2 0													

*High frequency only, 85; radium only, 7; H. F. T. plus radium, 4.

heaped up margins. The lesion extended about the region of the left ureteral orifice across the trigone almost to the right orifice. As it was deemed not resectable, it was treated by implantation of radium emanation seeds. The patient made a satisfactory convalescence but a follow up was not obtained.

CASE 20. M. R., a man of 52 years, admitted to the hospital in 1917 for hæmaturia at intervals for 3 years. He presented a large papillary tumor on the left side of the bladder for which fulguration was employed, at first in the hospital and later in the out patient department. On four occasions during his treatment biopsies were made, and examination in all revealed papilloma. After the superficial part of the growth was destroyed the base appeared solid and more resistant to the current. It is not clear from the records that it was ever completely removed during the year he was under treatment.

In 1920, he was admitted to the hospital for arteriosclerotic gangrene of a toe. Some blood was noted in the urinalysis. On cystoscopic examination a sessile papillary growth was found on the left side of the bladder extending toward the left ureteral orifice. A biopsy examination of the tumor proved it to be a papillary carcinoma, with invasion of the stroma (Fig. 27). At operation a segmental resection of the bladder was performed with the cautery.

TABLE IV.—END-RESULTS IN BLADDER TUMORS, 182 CASES

	Cases followed	Number arrested	Percentage arrested
I. Papilloma	60	48	80
II. Papillary carcinoma			
Non-infiltrating	21	9	43
Infiltrating	71	13	18
III. Non-papillary carcinoma.	30	5	16
Total	182	75	

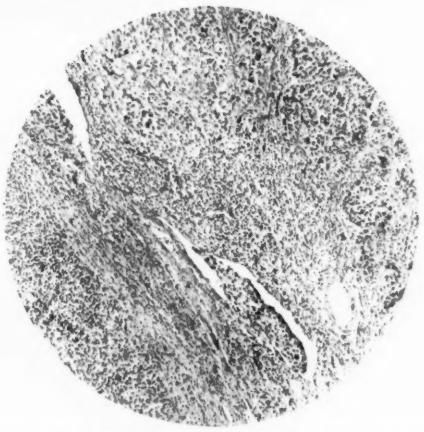

Fig. 17. Operative specimen showing stroma and stalk invasion, tumor cells in a lymphatic space. November 22, 1917. Papillary carcinoma (type 2d). Case 14. ×45.

Fig. 18. Biopsy specimen taken from case of recurrent papillary carcinoma. December 8, 1920. Case 14. ×75.

As a sufficient free area existed between the left ureteral orifice and the growth, ureteroneostomy was not necessary. The resected tumor was a papillary carcinoma which extended into the submucosal connective tissue but did not involve the muscularis (Fig. 28). During convalescence a small vesical calculus developed. An attempt to remove it cystoscopically under nitrous oxide anæsthesia resulted in accidental perforation through the recent suture line of the bladder. Laparotomy for repair of this injury was successful. Cystoscopic examination of this patient in 1927, 7 years after operation, showed no recurrence.

A review of the biopsy specimens removed in this case in 1917 when the patient first came for treatment was interesting and instructive. Of the four examinations all but the second showed typical papilloma as originally reported. In the fragments of the second specimen was one area of atypical cells with mitoses, growing in the stroma of a frond (Fig. 29). Upon this area, which was overlooked, a diagnosis of papillary carcinoma could have been made.

Case 21. I. R., aged 68 years, admitted to the hospital in 1918 for hæmaturia of 2 months' duration, presented a solid looking tumor on the left inferolateral wall of the bladder. A very meager specimen submitted for biopsy

Fig. 19. Operative specimen from case of recurrent papillary carcinoma infiltrating the muscularis. Case 14. ×36.

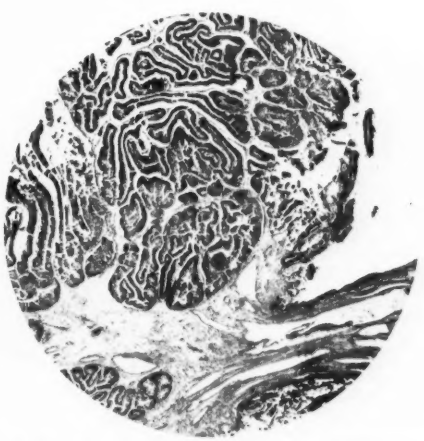

Fig. 20. Operative specimen of pedunculated papillary tumor with the architecture of a benign papilloma. Note pedicle, see next illustration. Case 15. ×10.

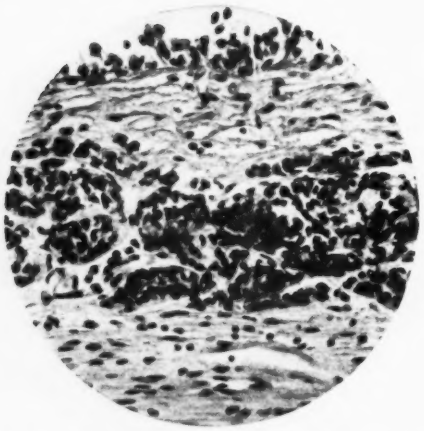

Fig. 21. Area of pedicle showing submucous invasion by tumor cells. Papillary carcinoma (type 2c). Case 15. ×180.

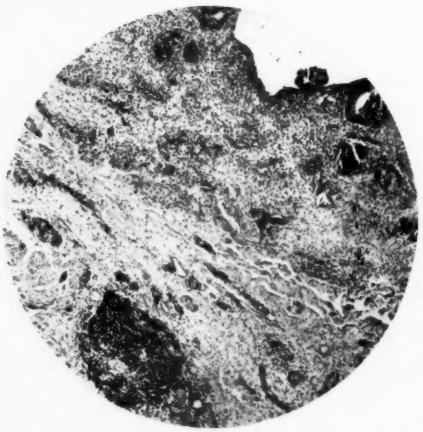

Fig. 22. Resected bladder wall showing some parts of the tumor which escaped destruction by diathermy. Islands of tumor cells in the submucosa and muscular coat. The cells themselves do not appear of malignant type. Papillary carcinoma (type 2c). Case 16. ×30.

was reported as papilloma. Fulguration was begun but the patient was lost from observation.

In 1921, he was readmitted for hæmaturia and presented a large, spherical, solid looking tumor on the left side of the bladder. Biopsy specimens (Figs. 30 and 31) showed undoubtedly papillary carcinoma with stroma invasion. At operation, only palliative cauterization of the infiltrating neoplasm was attempted. The patient died in uræmia a week later.

The case illustrates the error of reporting upon the insufficient material removed at the first biopsy.

CASE 22. L. T., a man of 48 years, was admitted for hypogastric tumor and dribbling of urine of 7 months' duration. Blood in urine had also been observed. He was found to have cerebrospinal lues and chronic retention of urine. The bladder was emptied gradually. A cystogram showed a huge bladder with a filling defect on the left side. Cystoscopy revealed a large papillary tumor which seemed to spring from the anterior wall near the sphincter and a more solid growth on the left lateral wall. Biopsy specimens presented fragments of tumor tissue which for the most part appeared benign, but there were areas of solid

Fig. 23. Biopsy section from edge of suspected tumor area. Irregular dark staining cells growing between the strands of fibrous tissue are seen. Papillary carcinoma (type 2d). Case 17. ×75.

Fig. 24. The tumor pedicle found at edge of the resected bladder wall. Small pyknotic cells in nests and strands growing in the fibrous tissue. Papillary carcinoma (type 2d). Case 17. ×13.

Fig. 25. Biopsy of a papillary tumor. Several fragments were typical papilloma. This fragment, however, showed a frond with malignant cells growing in the stroma. Papillary carcinoma (type 2d). Case 18. ×75.

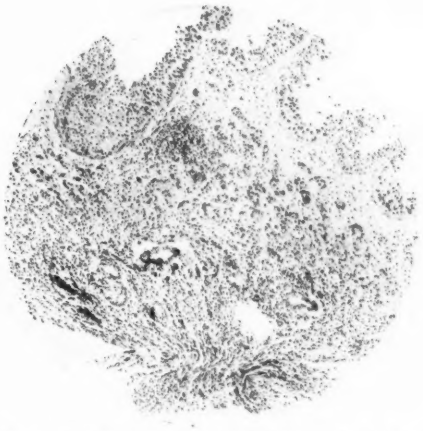

Fig. 26. Biopsy from edge of large ulcer left after destruction of a papillary tumor by endovesical fulguration. Shows submucosal invasion by tumor cells. Papillary carcinoma (type 2e). Case 19. ×45.

masses of cells irregular in shape, size, and arrangement, with tendency to squamous type (Fig. 32). These atypical areas warranted the diagnosis of papillary carcinoma.

At operation there was found a papillary tumor the size of a peach with a broad pedicle, arising from the left side of the bladder, without gross evidence of infiltration. About a dozen smaller papillary growths were scattered on the anterior and posterior walls. The largest tumor was treated by surgical diathermy and then excised with its base by the endotherm knife. The base of the pedicle showed infiltration by tumor cells growing between the muscle fibers of the bladder wall (Fig. 33). One of the smaller tumors removed in a similar manner presented in its pedicle a fair sized vein adherent to the wall of which was a thrombus containing cancer cells (Fig. 34). The patient had cystoscopic evidence of recurrence 8 months after operation. Treatment of the luetic condition had completely relieved the urinary retention.

NON-PAPILLARY CARCINOMATA

Non-papillary carcinomata are characterized by their tendency to spread from the surface of the bladder laterally under the normal mucosa and downward into the submucous, muscular,

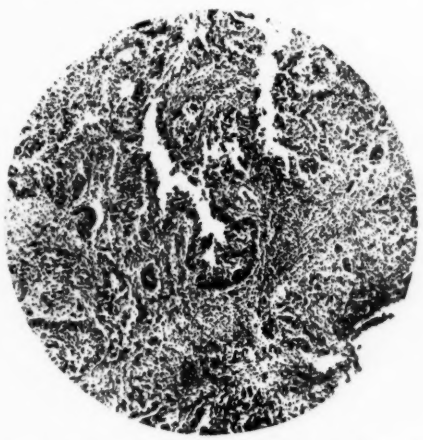

Fig. 27. Biopsy of sessile papillary tumor for which patient had been treated three years previously by fulguration. Papillary carcinoma (type 2d). Case 20. ×45.

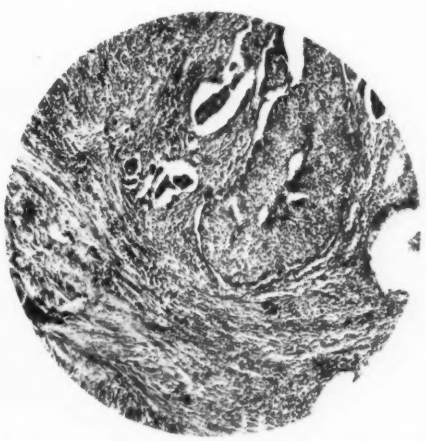

Fig. 28. Photomicrograph of resected tumor showing submucosal invasion. Papillary carcinoma (type 2e). Case 20. ×45.

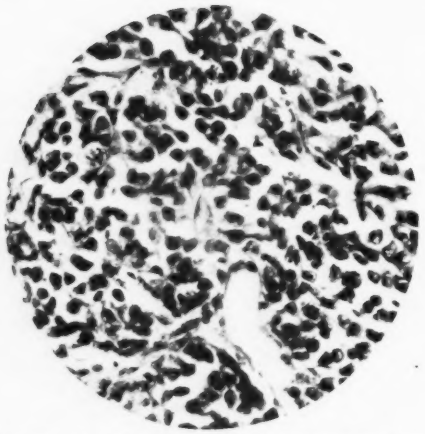

Fig. 29. Area of atypical cells with mitoses growing in the stroma. From second biopsy when patient first came for treatment. Three other biopsies showed typical papilloma. Papillary carcinoma (type 2d). Case 20. ×240.

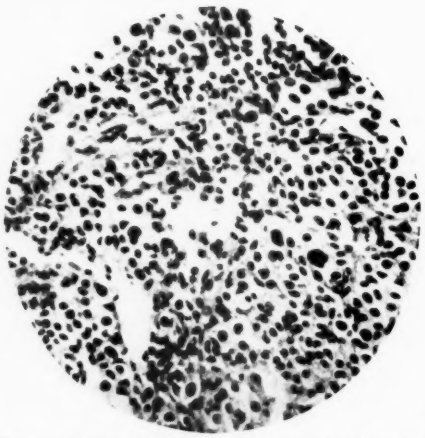

Fig. 30. Biopsy showing variation in size of cells and nuclei, irregularity of arrangement. Papillary carcinoma (type 2d). Case 21. ×180.

and adventitial tissue of the bladder. They may arise in any part of the bladder but are commonly situated on the posterior wall or at the base involving the interureteric ridge, the trigone, and the vesical neck. Frequently ulceration and necrosis are present at the center of the growth, the edge of which appears as a thickened, œdematous, heaped up margin. Occasionally a neoplasm of this kind appears simply as an elevated, localized, thickened area of the bladder wall which can be differentiated from an inflammatory process only by resort to biopsy, and even this may fail if the proper material is not obtained. Others project into the lumen of the bladder but are solid in appearance, lacking the fronds of the papillary tumors.

Ulcerated necrosed papillary carcinomata which have infiltrated the muscularis and the flat non-papillary carcinomata can usually be diagnosed by cystoscopy and bimanual palpation for infiltration. Although a biopsy may not give evidence of the true extent of the lesion, nevertheless it is

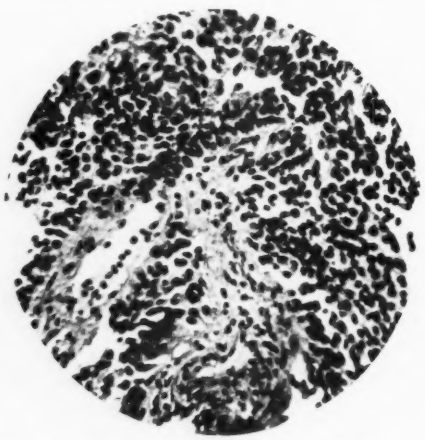

Fig. 31. Another area of same biopsy specimen as in Figure 30 showing stroma invasion. Case 21. ×180.

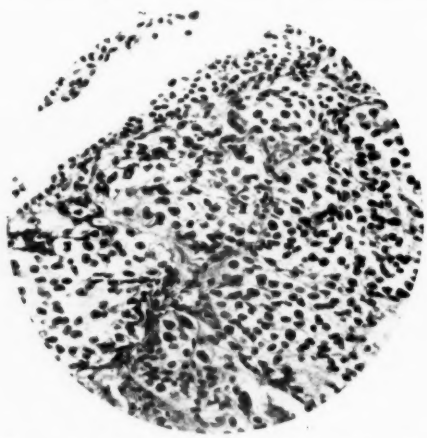

Fig. 32. Biopsy. Area of solid nests of cells varying in size, shape and arrangement, irregular nuclei and mitoses. Papillary carcinoma (type 2a). Case 22. ×150.

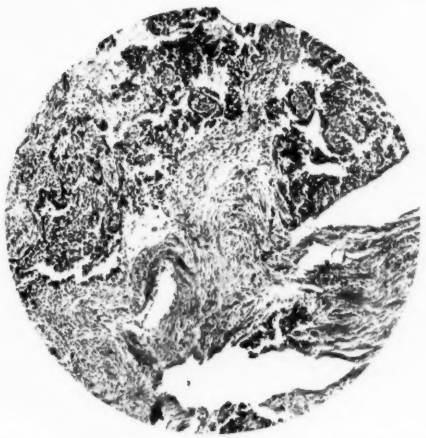

Fig. 33. Operative specimen. Infiltration of the base of the pedicle. Papillary carcinoma (type 2f). Case 22. ×45.

Fig. 34. Operative specimen. Tumor cells in a blood vessel of a tumor's pedicle. Case 22. ×80.

advisable to have histological evidence of malignancy before recommending radical surgery to the patient.

Histologically, the flat carcinomata seem to arise from the deeper cells of the mucosa, nests of which are frequently seen dipping downward in inflammatory processes, especially at the trigone and vesical neck. The growth may present much fibrous tissue between the strands of small pyknotic tumor cells, the scirrhus variety (Fig. 35) or they may be almost entirely cellular with large atypical cells and numerous mitoses, the medullary transitional cell variety (Fig. 36). The so called glands of von Brunn, cystitis cystica lesions, and embryonal rests may give rise to adenocarcinoma (Fig. 37). Metaplasia, or more correctly prosoplasia, of the transitional epithelium of the bladder accounts for the squamous variety of carcinoma (Fig. 38). The existence of leucoplakia in the bladder is a predisposing cause for squamous cell carcinoma. An ulcer on the anterior bladder wall less than a centimeter in diameter gave evidence of such change in the biopsy material (Fig. 39). At

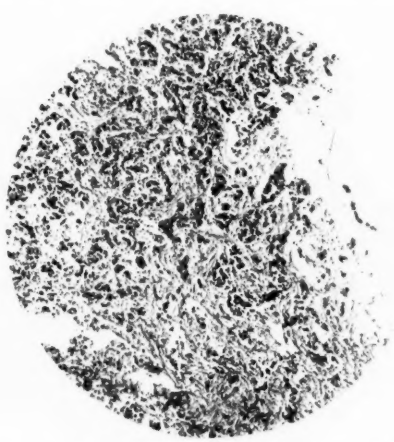

Fig. 35. Biopsy specimen of fibrocarcinoma (scirrhus) (type 3a). Case 22. ×45.

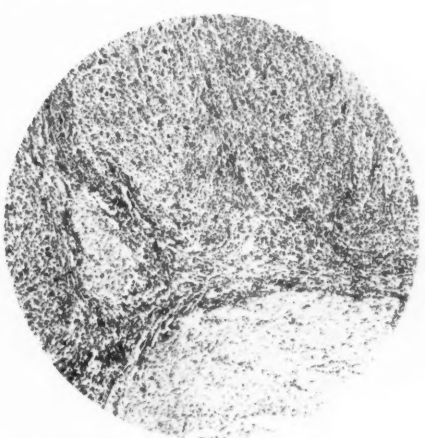

Fig. 36. Operative specimen, medullary carcinoma (type 3b). ×45.

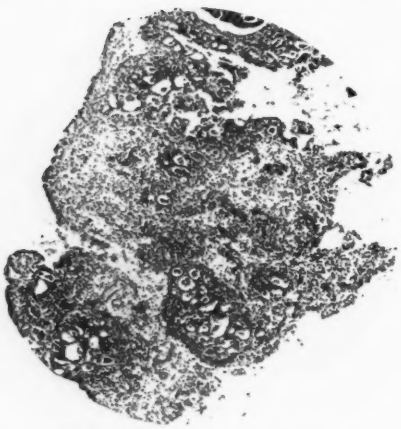

Fig. 37. Biopsy. Adenocarcinoma arising from the glands of von Brunn (type 3c). ×45.

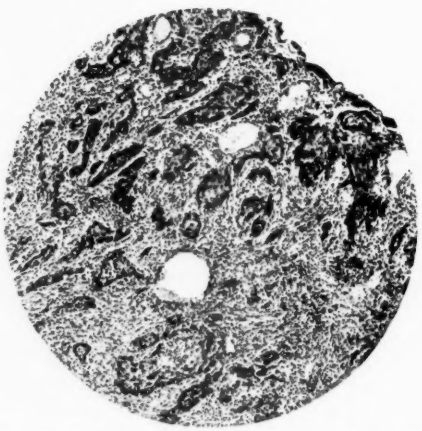

Fig. 38. Operative specimen. Squamous cell carcinoma (type 3d). ×45.

operation it was found to be in an area of leucoplakia. The neoplasm had not yet involved the muscularis (Figs. 40 and 41). In some instances well developed pearl formation occurs and a hornifying carcinoma results (Fig. 42).

BIOPSY IN LESIONS SIMULATING NEOPLASM

A considerable variety of lesions of the bladder may simulate neoplasm and confuse even the most experienced cystoscopist. A biopsy may be invaluable therefore in avoiding therapy, surgical or otherwise, misdirected and even contra-indicated for the case. As examples one may enumerate the following: bullous œdema, cystitis cystica and glandularis, impacted ureter stone, polypoid tuberculosis of the ureteral orifice, leucoplakia with infection, incrusted cystitis, inflammatory lesions, and callous ulcers of the bladder. The reaction to oft repeated and over-enthusiastic application of the high frequency method of treatment has produced at times a brawny infiltration simulating extensive, infiltrating carcinoma, and the failure to confirm the clinical impression by biopsy led to an unnecessary and in fact harmful resection of the bladder and ureter orifice in one of our own

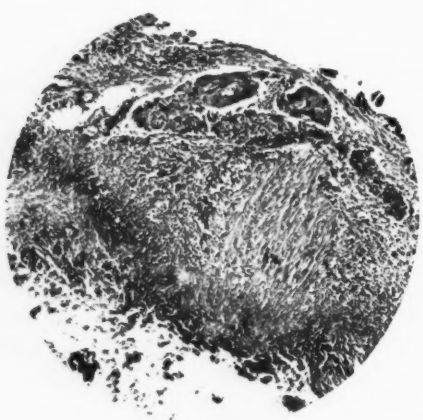

Fig. 39. Biopsy from small ulcer of anterior wall of bladder. Diagnosis of squamous cell carcinoma. ×45.

Fig. 40. Operative specimen in preceding case. Squamous cell carcinoma (type 3d). ×45.

Fig. 41. Leucoplakia of the bladder from which the carcinoma arose. ×120.

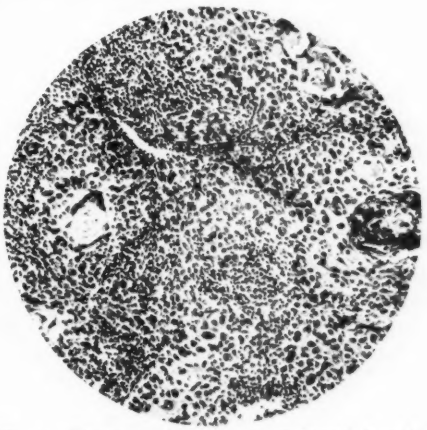

Fig. 42. Biopsy section from an inflamed hornifying carcinoma. ×75.

cases. A young woman was referred from the out patient department with the cystoscopic diagnosis of infiltrating carcinoma of the posterior bladder wall. A biopsy showed œdema and inflammation. So closely did the lesion simulate neoplasm that two additional biopsies were made with the same result. The history of an iodine douche accidentally entering the bladder and followed by immediate vesical symptoms was then elicited. The lesion disappeared gradually without treatment.

ASSOCIATED LESIONS, SECONDARY TUMORS

Patients with tumors of the bladder not infrequently present vesical calculi, prostatic hypertrophy, and vesical diverticula. Diverticula occurred in 12 of the cases of this series and in 8 of these the tumor was situated either within the diverticulum or at its orifice. Secondary involvement of the bladder by extension from a carcinoma of the prostate was suspected in 4 cases from the biopsy material and this was confirmed by the clinical findings and subsequent course.

DIAGNOSTIC VALUE OF THE BIOPSY

In Table III a summary of the 285 cases analyzed in this study is presented. Biopsy was performed by procuring tissue with the cystoscope in 242 cases. An erroneous diagnosis was rendered upon the material submitted in 12 cases, about 5 per cent. In my review of the original microscopic preparations, 7 of these reports were found to be true errors in that a correct diagnosis would be rendered today upon the basis of accumulated knowledge and experience with this type of work. In the 5 remaining cases the error was unavoidable for reasons already pointed out in the paragraph entitled "Sources of Error in Biopsy Diagnosis." Of the 242 cases a correct diagnosis, therefore, could be made in 237, about 97.5 per cent.

PROGNOSIS

In Tables III and IV the end-results are noted in 182 cases in which the termination of the case is known or in which a follow up of not less than 3 years is available. Only those cases are regarded as arrested in which the final cystoscopic control showed no evidence of recurrence and in which clinical examination showed no evidence of metastasis.

If cytologic criteria alone indicated the prognosis, one would expect a decided difference in the number of arrested cases in groups II A (non-infiltrating carcinoma with slight atypism) and II B (with more diffuse and marked atypism) but the percentages are almost identical, 44 and 42 respectively.

If bladder wall infiltration indicated the prognosis then group II F (papillary carcinoma infiltrating muscularis and perivesical fat) and group III (non-papillary infiltrating carcinoma) should show similar results; which is the case in this series, 14 and 16 per cent respectively.

If one compares the non-infiltrating papillary carcinomata (II A and B) with the infiltrating papillary carcinomata (II C, D, E and F) the percentage of arrested cases is 43 and 18 per cent respectively (see Table IV). The unusually

good results obtained in group II E (papillary carcinoma with submucosal base invasion) is ascribable to the fact that in 7 of the 17 cases, an adequate segmental resection of the bladder was feasible.

Cases which present the cystoscopic or operative findings of papillomatosis are treacherous from the standpoint both of diagnosis and prognosis. Of 13 such cases in this series 9 were benign in their course and 4 proved to be malignant.

From what has already been said regarding our inability to determine the question of infiltration and extent of the lesion by biopsy alone, and from the deductions drawn concerning the importance of infiltration in prognosis, it is evident that prognosis in bladder malignancy cannot and should not be attempted from biopsy material alone. For the individual patient the prognosis cannot be made on any single basis; all malignancy is grave for him.

CONCLUSIONS

1. Reliable information as to the nature of bladder tumors is obtained by cystoscopic biopsy in 97.5 per cent of cases. The unavoidable failures occur chiefly in multiple tumors and in papillomatosis.

2. Prognosis cannot be made from biopsy material alone in cases of malignancy.

3. A biopsy diagnosis of malignancy in a case simulating papilloma by cystoscopy and response to fulguration is a signal for more radical therapy (radium or surgery).

4. Bladder tumors may be classified in a manner harmonious with general tumor terminology and with clinical requirements. They are benign or malignant.

5. Classification based upon cell grading alone is not as practical for clinical purposes, and prognosis on such basis does not coincide with the late results in this series of cases.

6. The presence or absence of infiltration appears to be a more reliable guide to the gravity of the situation.

7. The site of the malignant tumor determines its resectability and thus influences prognosis materially.

8. If a biopsy diagnosis of carcinoma is made and the case is considered surgical, segmental resection of the whole thickness of the bladder wall is the procedure of choice. Failure to do so even in the pedunculated tumors has often resulted in recurrence. Stalk invasion and tumor cells in the blood vessels at the base cannot be detected by gross inspection.

9. As only 30 of 138 papillary carcinomata showed no evidence of infiltration, it is probable that types II A and B represent an earlier stage in the development of the disease.

Although histological studies tempt one to believe that papillary carcinoma develops from papilloma in a considerable percentage of cases evidence thereof is very equivocal.

10. Before undertaking radical surgery for tumor of the bladder, a biopsy should be made, as other lesions may resemble neoplasm very closely.

My thanks are due to Dr. Paul Klemperer who checked up the microscopic diagnoses which I made and to Dr. Edwin Beer for use of the clinical data.

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CANCER OF THE BREAST

An Analysis of One Hundred and Eight Cases of Cancer of the Breast; A Clinical Index of Malignancy

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THIS paper is based on a series of 108 consecutive unselected cases of cancer of the breast. They were taken from the First Surgical Division of the New York Hospital. The series represents all the cases diagnosed as cancer of the breast on this division from 1912 through 1928.

TABLE I.—INCIDENCE

Year	No. of cases of breast cancer	Cancer—all kinds (pathologically), (anatomically)	Total cases discharged from 1st surgical division each current year
1912	1	..	.....
1913	6	..	.....
1914	9	28*	997*
1915	8	63	2,364
1916	9	48	1,698
1917	12	47	1,883
1918	6	45	1,514
1919	6	52	1,473
1920	3	26	1,482
1921	8	46	1,600
1922	7	102	1,691
1923	6	33	1,594
1924	5	40	1,506
1925	8	46	1,541
1926	2	40	1,516
1927	5	48	1,751
1928	7	52	1,793
Total	108	716	24,403

*For last 6 months only.

For a 15 year period, 1914–1929, breast cancer was 15 per cent of all the cancer cases diagnosed and treated on this division. During this same period it represented 0.44 per cent of all the cases discharged from the service. It was a surprise to find only 108 cases diagnosed as cancer of the breast over this long period of years. Especially, since there is such a rapid surgical turnover each year on this division.

TABLE II.—MARITAL INCIDENCE

	Cases	Per cent
Single	21	19
Married	56	51
Widowed	31	30
Total	108	100

Cancer of the breast is found more often in married women or those previously married than in unmarried women, i.e., unmarried patients 19 per cent, married 81 per cent of the total number of cases. In 563 cases of Schreiner, 84 patients were unmarried (15 per cent), while 479 patients were married (85 per cent). Just what is the significance of these findings in relation to the etiology of mammary cancer, I am unable to say. In this connection there are many factors. It is natural to suppose after examination of the incidence that lactation and pregnancy, also trauma from breast feeding, have something to do with mammary cancer. Lee (7) believes that prior lactation is not an important factor in the development of mammary cancer.

TABLE III.—RACIAL INCIDENCE

	Cases		Cases
United States		English	4
White	44	French	2
Colored	2	Scotch	2
Irish	19	Canadian	1
Italian	14	Mexican	1
German	8	Porto Rican	1
Russian	5	Turkish	1
Austrian	4		108

There is nothing conclusive as to the racial incidence of cancer of the breast in this series (Table III). First, the series is too limited in number. Second, the United States group is too wide in its scope, it being a composite of many races. But one is impressed by the infrequent occurrence of carcinoma of the breast in colored women.

Cancer of the breast is especially prevalent in the decades 40 to 60 years. More than one-half of the cases had cancer between these years. The youngest patient was 26, while the oldest was 70 years of age.

TABLE IV.—AGE INCIDENCE

Age in years	Cases	Per cent
20–30	4	3
30–40	19	18
40–50	33	30
50–60	32	30
60–70	20	19
Total	108	100

In Schreiner's series 58 per cent of all the cases occurred between the ages of 40 and 60 years. The statistics of Moschcowitz showed that 113 cases (51 per cent) occurred between the ages of 40 and

60 years in a total of 218 cases. Judd had 285 cases (43 per cent) between the years 40 and 60 in his series of 651 cases.

TABLE V.—SITUATION OF THE TUMOR

	Cases	Per cent
Right breast	56	52
Left breast	49	46
Bilateral	3	2
Total	108	100
Schreiner's figures		
Right breast	244	45
Left breast	275	49
Both breasts	34	6
Total	553	100

The chances of involvement of one breast or the other are about equal.

Ewing states in his book that there is a slight predominance in the left breast. The location of the tumor was present in the right breast in 102 cases (47 per cent) and in the left breast in 116 cases (53 per cent) (Moschcowitz).

Finney writes that the tumor appears with about equal frequency in the breasts, although in individual clinics one or the other breast may show a preponderance. The cases which had bilateral involvement, save one, did not present themselves as such, but rather, the cancer appeared in the remaining breast some time after radical amputation had been performed.

CASE A. Both breasts were involved. In addition there were extensive metastases to the neck and lungs. Biopsy was performed and diagnosis of carcinoma was established. The patient died 11 months later.

CASE B. The left breast was involved for which a radical amputation was performed. Three years later the right breast became involved and a radical amputation of the right breast was performed. The patient died 4 years later.

CASE C. The right breast was the primary seat of the cancerous process. A radical amputation of this breast was done. Nine years later the patient was re-admitted with the diagnosis of cancer of left breast, and a radical amputation was performed. She died 19 months later.

TABLE VI.—EXTENT OF DISEASE

	Cases	Per cent
Metastases to lymph nodes	61	63
No metastases to lymph nodes	27	28
Not mentioned in report	8	9
Total	96	100
Moschcowitz's cases		
Lymph nodes involved		56
Lymph nodes not involved		35
Not mentioned		9
		100

The extent of the disease was determined from the pathological report. Clinical evidence of metastases to the nodes was often lacking, although later checking up with the microscope revealed involvement of the nodes. The cases in which there was involvement of the nodes greatly outnumbered those in which the breast alone was diseased.

This may mean that the nodes have been involved early so that when the patient becomes aware of the primary growth and seeks medical advice, metastases have long since appeared. Of course, the finding of a lump in the breast is often accidental. The history of noticing a lump for the first time while bathing is common enough. Education has a rôle in this connection. To teach the laity the significance and the potential dangers of a tumor in the breast would mean, in many cases, an early visit to a physician. To be sure more benign tumors, as well as malignant tumors, would be seen. In fact, tumors of the breast which do not exist would be the center of attention of some patients. In these cases a careful physical examination and reassurance would suffice. In other cases an early recognition of the process would mean early treatment; and it is only through early treatment that we can hope for the best and lasting results.

"Not 25 per cent of women with cancer of the breast obtain surgical treatment before their disease has gotten beyond the first stage. Sir George Newman, in his preface to the present work, says: 'It is not because the disease advances rapidly. . . . The prime need in reducing mortality . . . is not extended hospital accommodations, not improved methods of treatment nor even diagnosis.' *It is avoidance of delay.* The essence of the situation is to assure that cancer of the breast is recognized immediately and is immediately treated." (2).

TABLE VII.—PATHOLOGY

	Cases	Per cent
Cancer (type not stated)	30	31
Scirrhus carcinoma	26	27
Carcinoma simplex	11	12
Fibrocarcinoma	9	10
Cellular carcinoma	4	4
Duct carcinoma	3	3
Gelatinous carcinoma	3	3
Medullary carcinoma	3	3
Alveolar carcinoma	2	2
Adenocarcinoma	1	1
Papillary cystadenocarcinoma	4	4
Total	96	100

White noted that the proportion of private patients without axillary metastases is much greater than in the ward cases.

An arbitrary standard was set designating the size of the growth. A tumor measuring up to 3 centimeters in diameter was considered small;

up to 8 centimeters large. There were 34 cases (31 per cent) of small tumors and 74 cases (69 per cent) of large tumors.

TABLE VIII.—CLINICAL CLASSIFICATION

	Cases	Per cent
Primary operable	92	85
Primary inoperable	12	11
Recurrent operable	1	1
Recurrent inoperable	3	3
Total	108	100

The classification used is according to Lee (7, 8, 9).

Primary operable: A tumor in the breast which is not fixed to the chest wall, and is with or without axillary nodes, is operable.

Primary inoperable: One or more of the following factors are present: (1) fixation of breast tumor itself to chest wall (with fixed axillary nodes); (2) supraclavicular nodes involvement; (3) involvement of opposite axillary nodes; (4) distant metastases to chest and bones; (5) diffuse subcutaneous nodules; (6) diffuse inflammatory cancer involving a considerable skin area; (7) chest metastases pleural or mediastinal; and (8) remote metastases.

Recurrent operable: One or two small, accessible, isolated nodules as local recurrences found after former operation, with or without involvement of the axillary nodes.

Recurrent inoperable: The recurrent inoperable cases include (1) recurrent diffuse subcutaneous nodules in the operative field; (2) single fixed recurrence to chest wall; (3) the presence of axillary nodes in the same side with extension well up beneath the clavicle; (4) well marked fullness of supraclavicular fossa of the involved side with or without palpable nodes; (5) involved nodes present in opposite axilla; (6) evidence of involvement of opposite breast; (7) intrathoracic metastases; (8) any recurrence that follows operation on an inflammatory cancer of the breast; (9) metastases to bone; and (10) metastases to distant organs.

TABLE IX.—TYPE OF OPERATION

	Cases	Per cent
Radical amputation	89	93
Incomplete radical amputation	1	1
Local excision	6	5
Palliative mastectomy	1	1
Total operative cases	97	100
No operations	11	
Grand total	108	

The cases were treated individually. A radical amputation (Halsted, Willy Meyer) was the method of choice with a wide excision of tumor, with axillary dissection and removal *en masse*.

TABLE X.—METASTASIS

	Cases	Per cent
Chest	15	24
Spine	9	14
Local recurrence	8	12
Stomach	6	9
Axillary	5	8
Liver	5	8
Bones other than spine	4	7
Abdomen	4	7
Nodes of neck	4	7
Distant skin metastases	2	3
Brain	1	1
	63	100
No evidence of metastases	14	
Total	77	

There was definite information concerning presence or absence of recurrences in 77 of the cases. For the 31 other cases no data could be obtained on this point.

It is a well known fact that metastasis to bone is a common occurrence in cancer of the breast. The metastases to the chest, spine, and long bones of the body were 45 per cent of all the metastases found in this series. Schreiner found that recurrence followed surgical operations regardless of whether they were complete or incomplete. In one-third of the 9 known instances of recurrences in Delbet's series of 15 cases of cancer of the breast metastases occurred in the pleura and lungs. Bendick advocates taking two roentgenograms; a pelvic roentgenogram and a chest roentgenogram. On a single 14 by 17 inch film one can get the lumbar spine, pelvic bones, and both hips. It would seem wise to roentgenograph not only the chest but also the spine, pelvis, and long bones as a pre-operative routine measure. White says that he takes roentgenograms of the chest, spine, and pelvis before operation, but he adds that the roentgenogram does not necessarily reveal the early bone metastases. However, it is a practice that should be carried out. An occasional positive finding would justify this measure.

END-RESULTS IN THIS SERIES

Since this was to be a statistical study, I decided to determine first the end-results of all the cases just as they came without fixing a 5 year period following operation to record the number of the "cured" cases. Our follow-up system was started in February, 1913. Of the 107 cases that were followed up, 94 cases were seen at the clinic or heard from through letters or nurses. A report

was made of the date of death, the cause of death in some cases, and the condition of the patient when last seen. The system showed an 87 per cent efficiency.

TABLE XI.—END-RESULTS

	Cases	Per cent
Death or result after operation:		
First 6 months after operation	18	19
1 year after operation	21	22
2 years after operation	13	13
3 years after operation	11	12
4 years after operation	5	5
5 years after operation	6	6
7 years after operation	2	2
8 years after operation	1	1
12 years after operation	2	2
Living {alive and well	10	10
Living {alive with recurrences	7	8
No trace	11	
Total	107	100
Lost track of 11 patients.		
6 months after operation	3	
1 year after operation	4	
2 years after operation	2	
3 years after operation	1	
4 years after operation	1	
Total	11	

Three patients died of intercurrent diseases, one of heart trouble; another of paralytic stroke; another of pulmonary embolus. The cause of death in the other cases was due to cancer so far as we can tell.

A 5 year limit following operation was next considered. There were 84 cases in all which had a 5 year or more postoperative period. Analysis of this group is shown in Table XI A.

TABLE XI A.—FIVE YEAR RESULTS

	Cases	Per cent
Living	7	9
Dead	65	91
No trace	12	
Total	84	100

Twelve cases were placed under "No trace" heading following Lee (10) that patients dying from intercurrent disease before the expiration of 5 years but without evidence of cancer have been excluded from statistical study as well as those who have been completely lost track of.

There were only 9 per cent of the cases in this group living and well 5 years after operation. This figure is lower than one generally thinks of in connection with "cures" for mammary cancer.

CLINICAL INDEX OF MALIGNANCY

Recently Lee (11) graded 100 primary operable cases of cancer of the breast from clinical data alone to determine if such data would give an accurate estimate of the degree of malignancy. We considered the age of the patient, the presence or absence of lactation, the rate of growth of the tumor, and the extent of the disease so called weighting factors (Table XII A).

TABLE XII A.—WEIGHTING FACTORS

Age	A = 2
Lactation	L = 3
Rate of growth	R = 4
Extent of disease	E = 5

The weighting factors were subdivided and evaluated and these subdivisions were known as gradation factors (Table XII B).

TABLE XII B.—GRADATION FACTORS

	Weighting factors	Gradation factors		
Age	A = 2	A_G	Over 55	= 1
			41–55	= 2
			40 or under	= 5
Lactation	L = 3	L_G	Absent	= 0
			Present	= 3
Rate of growth	R = 4	R_G	Slow	= 1
			Moderate	= 2
			Rapid	= 4
Extent of disease	E = 5	E_G	Small (3 cm. or less)	= 1
			Large	= 2
			Nodes present	= 4

The clinical index of malignancy for any individual was then calculated by multiplying the value of each weighting factor by its gradation factor and adding the results as: Clinical index of malignancy $= 2A_G + 3L_G + 4R_G + 5E_G$. A patient of 57 years of age having a small tumor which has been growing over a number of years would be placed in Grade A as—clinical index of malignancy $= 2 \times 1 + 3 \times 40 + \times 1 + 5 \times 1 = 11$— whereas a young woman 28 years of age with a rapidly growing tumor and with involvement of axillary nodes would be placed in Grade C as: clinical index of malignancy $= 2 \times 5 + 3 \times 0 + 4 \times 4 + 5 \times 4 = 46$. Based on such calculations patients were placed into one of the three grades.

Grade A 11—25 relatively benign
Grade B 26—39 Moderately malignant
Grade C 40—55 highly malignant

The results obtained in the series were as follows:

Grade A—relatively benign—69 per cent of patients were alive and well, 5 years or more;

Grade B—moderately malignant—34 per cent of patients were alive and well, 5 years or more;
Grade C—highly malignant—4 per cent of patients were alive and well, 5 years or more.

Thus a reasonably accurate prognosis can be given by the use of the clinical index of malignancy.

Next we considered whether the clinical or histological grading would furnish a more accurate prognosis. Dr. Ewing graded these same cases as:

Grade 1—relatively benign—52 per cent were alive and well, 5 years or more;
Grade 2—moderately malignant—33 per cent were alive and well, 5 years or more;
Grade 3—highly malignant—29 per cent were alive and well, 5 years or more—

thereby showing that the clinical grading made a more accurate selection of the patient than did the histological grading and gave a more accurate prognosis.

Believing it would be interesting to find out whether or not similar results would be obtained in a survey of another group of cases, I analyzed the same series in the same way. There were 65 appropriate primary operable cases and the clinical index of malignancy was calculated in each case. The results are shown in Table XIII.

TABLE XIII—CLINICAL GRADING

Grade A*	Relatively benign	No. of Patients	Percentage
Alive and well	5 years or more	3	19
Dead within	1 year	3	19
	2 years	4	25
	3 years	1	6
	4 years	1	6
	5 years	4	25
Grade B	Moderately malignant		
Alive and well	5 years or more	1	2
Dead within	1 year	9	24
	2 years	11	29
	3 years	7	19
	4 years	3	8
	5 years	6	18
Grade C	Highly malignant		
Alive and well	5 years or more	1	8
Dead within	1 year	5	42
	2 years	1	8
	3 years	4	34
	4 years	..	..
	5 years	1	8

*The 3 cases mentioned above dying from intercurrent disease fell in Group A thus tending toward a higher mortality rate for this group.

Grade A—relatively benign—19 per cent of patients were alive and well, 5 years or more.
Grade B—moderately malignant—2 per cent of patients were alive and well, 5 years or more.
Grade C—highly malignant—8 per cent of patients were alive and well, 5 years or more.

A similar histological classification was done. Table XIV shows Dr. Lawrence W. Smith's gradation of these same cases.

TABLE XIV—HISTOLOGICAL GRADING

Grade 1	Relatively benign	No. of patients	Percentage
Alive and well	.....	..	..
Dead within	1 year	..	..
	2 years	1	100
	3 years	..	..
	4 years	..	..
	5 years	..	..
Grade 2	Moderately malignant		
Alive and well	.....	3	18
Dead within	1 year	3	18
	2 years	4	23
	3 years	2	12
	4 years	1	6
	5 years	4	23
Grade 3	Highly malignant		
Alive and well	.....	2	4
Dead within	1 year	16	34
	2 years	9	20
	3 years	8	17
	4 years	4	8
	5 years	8	17

Grade 1—relatively benign—0 per cent were alive and well, 5 years or more.
Grade 2—moderately malignant—18 per cent were alive and well, 5 years or more.
Grade 3—highly malignant—4 per cent were alive and well, 5 years or more.

A comparative analysis of the clinical and the histological grading is given in Table XV.

TABLE XV

Grade A			Alive and well	Dead within 1 yr.	2 yrs.	3 yrs.	4 yrs.	5 yrs.
Alive and well	3	.....	.	.	.	.	.	.
Dead within 1 year	3	Grade 1	.	.	.	.	.	.
2 years	4	.....	.	.	.	.	.	.
3 years	1	Grade 2	2	1	2	.	.	1
4 years	1	.....	.	.	.	.	.	.
5 years	4	Grade 3	1	3	1	1	1	3
Grade B								
Alive and well	1	.....	.	.	.	.	.	.
Dead within 1 year	10	Grade 1	.	.	1	.	.	.
2 years	11	.....	.	.	.	.	.	.
3 years	7	Grade 2	1	2	2	2	1	3
4 years	3	.....	.	.	.	.	.	.
5 years	7	Grade 3	.	8	7	4	2	4
Grade C								
Alive and well	1	.....	.	.	.	.	.	.
Dead within 1 year	5	Grade 1	.	.	.	.	.	.
2 years	1	.....	.	.	.	.	.	.
3 years	4	Grade 2	.	.	.	.	.	.
4 years	.	.....	.	.	.	.	.	.
5 years	1	Grade 3	1	5	1	3	1	1

Although these results are very different from those obtained by Lee yet again a clinical

grading makes a more accurate selection of the patient than did the histological grading and gives a more accurate prognosis.

CONCLUSIONS

1. That there were very few cases of cancer of the breast treated on this general surgical service.

2. Mammary cancer is found more often in married women than in unmarried women; to such an extent that one suspects that the incidence of mammary cancer in married women is dependent on some definite factor.

3. Patients coming to the hospital for treatment show a great predominance of already involved axillary nodes. Education and avoidance of delay after a tumor of the breast has been discovered would help to bring about better subsequent results.

4. The incidence of bony metastases is so high as to warrant pre-operative X-ray of chest, pelvis, and spine as a routine measure.

5. The end-results in this series are very discouraging. Only 9 per cent of the cases are living after a period of 5 years following operation.

6. A clinical grading of cancer of the breast makes a more accurate selection of the patient than does a histological grading and gives a more accurate prognosis.

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VESICAL NECK OBSTRUCTION

With Presentation of a New Instrument For Its Relief

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THE ideal of all surgery is the preservation of anatomical parts in normal relation. The degree of attainment of this ideal must be consistent with relief of the patient. But to remove ruthlessly by surgical intervention all tissues in pathological condition, is the course taken only by those who are prone to follow the line of least resistance. The principal points to be considered in conservative surgery are: first, relief of whatever pathological condition is present; second, conservation, with consideration of future prognosis; third, fulfilment of the two conditions just named with the utmost safety to the patient.

It has been my aim, in considering the problem of the removal of median bar obstruction, to design an instrument making possible the complete adherence to these three major surgical principles, and at the same time relieving the condition without resort to Herculean procedures often dangerous or even fatal. Before describing this instrument, I wish briefly to mention some of the methods previously used to relieve this obstruction.

These may be divided into three classes: (1) those employing the suprapubic route; (2) those necessitating blind removal *per urethram;* (3) those providing for removal under direct vision, but equipped with electric cautery devices which do not provide for accurate determination of the amount of cauterization. Various instruments designed to excise the bar, but without proper consideration for provision against post-operative hæmorrhage.

HISTORICAL SURVEY

When Wellington undertook the Peninsular Campaign his troops were accompanied by a young military surgeon named George James Guthrie. I use the word *young* advisedly, for Guthrie was born in 1785 and the Peninsular Campaign began in 1807. More than that Guthrie had been a certified army surgeon for 6 years previously, having passed his examinations and been assigned to a regiment when little more than 16. His military career lasted until after the final fall of Napoleon. Beginning as he did at such an early age, Guthrie's opportunity for observing the various pathological conditions to which the male urinary apparatus may be subject was exceptionally wide. This is attested by his book, *Anatomy and Diseases of the Urinary and Sexual Organs,* which was published after he began private practice. In this volume he arrives at the conclusion "that an elastic structure exists at the neck of the bladder and may be diseased without necessary connection with the prostate gland." Likewise "the prostate gland may be diseased without any necessary connection with the elastic structure." This appears to be the first recognition of what has come to be known as median bar obstruction at the vesical neck.

At the time it was published no particular attention was paid to Guthrie's observation, so that when a dozen years later a similar idea was promulgated in France it was hailed as quite original. Indeed, any connection of Guthrie's would hardly have been revived at all, had he not been cited by Civiale, the French urologist, in reply to his confrère Mercier's accusation that Civiale's writings on the subject of median bar obstruction had been plagiarized from his own. Even then Civiale designated him as "some English surgeon," without mentioning his name. There appears to be little doubt that Civiale's contribution was made prior to that of Mercier despite that choleric individual's furious outcry to the contrary. In his *Traité pratique sur les Maladies des Organes génito-urinaires* he states that he has made use of "le trilabe et le lithoclaste à écrou" since 1824. "These instruments," he tells us, "are introduced into the bladder, where they are opened in such a manner as to give the vesical extremity a volume proportionate to the dilatation it is desired to produce. The instruments are then withdrawn dilating the tract along which they pass, from behind forward. Should it be desired to effect further dilatation at the same sitting, they should be closed when they have been pulled back as far as the membranous urethra, then reintroduced into the bladder, thereafter to be withdrawn in the same manner as before. The surgeon should never lose sight of the fact that this is decidedly heroic treatment, the abuse of which may lead to the gravest consequences; the maneuver should be carried out with the greatest care and prudence."

A controversy—largely of Mercier's making—was waged for a number of years between the two French urologists as to the priority in the investigation of the nature of median bar obstruction at the vesical outlet, and originality in the design of instruments for its relief. But Mercier, after the fashion of the Pharisees, succeeded by his "much speaking" in getting the entire credit for this important contribution to urology; even today the condition concerned is most frequently referred to as Mercier's bar. In 1850, the Academie Française des Sciences awarded Mercier a prize of 1,500 francs, crediting him among other things with having "perfected the construction of instruments, easy of handling, by aid of which one incises, or with the same, excises the valve, in a manner to produce a more certain and prompt cure."

If Mercier really did add anything to what Guthrie had already set forth in his writings and lectures it was not of sufficient interest to the practitioners of his time to keep the subject actively before them. We hear little more about median bar obstruction at the vesical outlet until the perfection of the cystoscope immeasureably increased the possibilities of urologic examination. Even then, so much more attention was paid to hypertrophy of the prostate and the pathology induced by its existence that the symptoms of median bar hypertrophy were confused or entirely overlooked. The *prostatisme sans prostate* of the French school of which Guyon was the leader during the last decade of the nineteenth century was a vague conception, blaming vesical obstruction in the absence of prostatic lobe enlargement upon muscular changes in the bladder wall induced by arteriosclerosis. It was not until 1901 that Charles H. Chetwood collected the various designations for the condition at that time prevalent, and suggested that in their place should be used a single name, originating with the elder Keyes—that is, *contracture of the neck of the bladder*

A few years later—in 1905—Chetwood again called attention to the subject and put forth what may justly be termed the first modern conception of median bar hypertrophy and its rational treatment. Contracture of the bladder neck, he pointed out, is a common cause of vesical obstruction; its relief is safe and sure by means of a galvano-prostatectomy through a perineal opening; it is often an explanation for what has been termed "prostatism without enlargement of the prostate."

The idea of using the cautery to remove obstruction at the vesical outlet was by no means a new one when Chetwood wrote. As far back as 1877 the Italian surgeon, Bottini, had suggested such a possibility and perfected an instrument which from time to time he called to the attention of the practitioners of urology. In 1900, Albert Freudenberg, of Berlin, described before the Thirteenth International Congress of Medicine convened at Paris, his employment of Bottini's procedure for the relief of prostatic hypertrophy, together with the instrument he had designed for this purpose, which he called a cystoscopic prostatic incisor. While it was patterned after Bottini's cautery, the cystoscopic features are apparently original with Freudenberg. So to him should be accorded the credit for creating the design which has since seen so many improvements and modifications at the hands of later surgeons.

During the next 20 years many minds were centered upon the development of instruments of this type and substantial progress was made. Minor alterations were made by Wossidlo and Goldschmidt in Europe while in this country revolutionary changes were inaugurated by Hugh Hampton Young, who first showed his instrument and reported his early cases before the Second International Congress of Urology in 1911, at Paris. Young's instrument is the prevailing type in use at present. All others are but modifications of one or another of its basic features. He has himself made substantial changes in it from time to time.

With a view to meeting the special problem offered by obstruction in the urethra, Maximillian

Fig. 1. Showing anomalous variations in the genitovesical arteries in the male subject. The genitovesical artery—properly so-called—bifurcates into the anterior hæmorrhoidal, *H*, and the prostatic, *P*. The first is well placed to supply its anterior vesical branch, as well as those going to the fat and the retrosymphysitic region, before leaving the pelvis. The prostatic—after giving off a small branch to the seminal vesicle—is wholly devoted to the prostate, ending in a long inferior anterior branch to the bladder. It is the umbilical, *O*, which, together with the deferential, *d*, arising directly from the hypogastric, supplements the deficiencies of the genitovesical.

Among the branches of the posterior umbilico-vesical destined for the subperitoneal layer of the bladder, the most posterior reaches the termination of the ureter in the trigone, where it gives off a recurrent twig, which detaches itself from an inferior vesical branch, which in turn is carried forward by a large vesiculodeferential branch, this being an offshoot of this same posterior umbilicovesical artery.

The vesicular branches ramify over both surfaces of the seminal vesicle; one advances to the ampullary portion of the vas deferens where it anastomoses with a descending branch of the autonomous deferential, *d*, which might very well be designated as the deferential-uterine. (After Farabeuf).

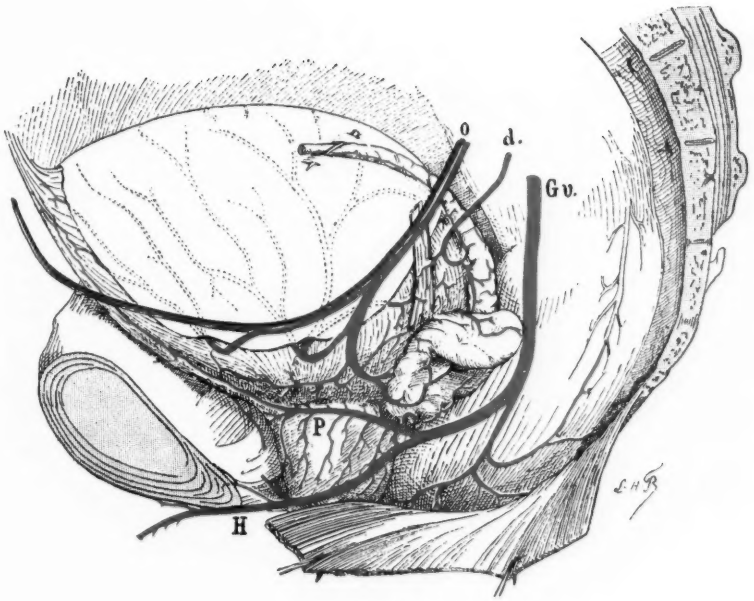

Fig. 1.

Vesical Neck Obstruction.—Thomas J. Kirwin.

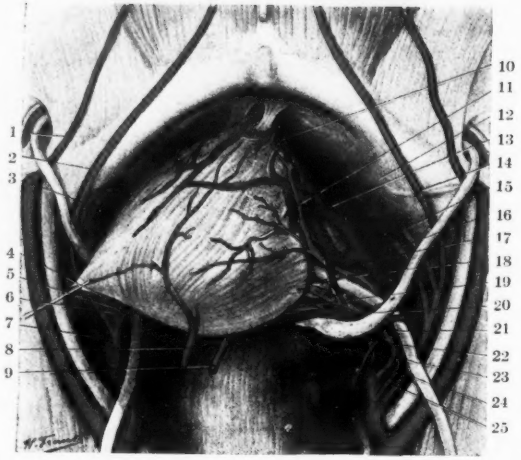

Fig. 2.

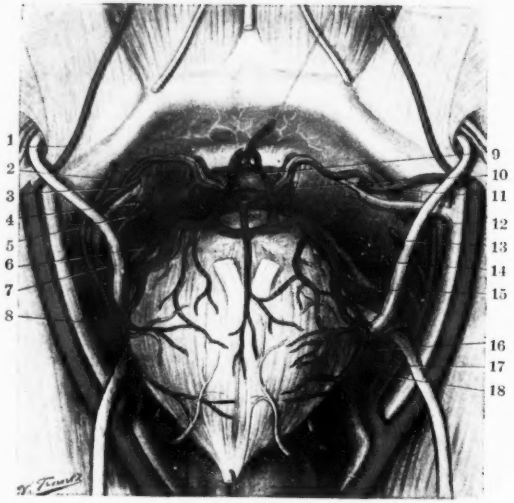

Fig. 3.

Vesical Neck Obstruction.—Thomas J. Kirwin.

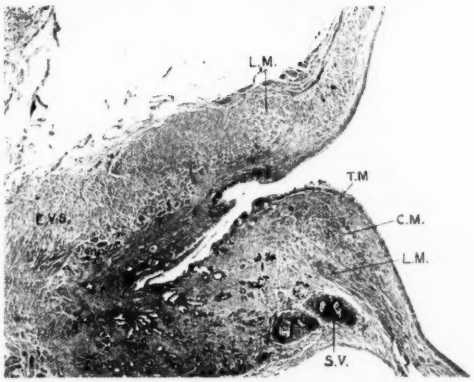

Fig. 4. Cross section of a 21 mm. human embryo. Ureters enter on dorsal surface of bladder (cloaca), not at lateral edge. (Courtesy of Dr. M. B. Wesson).

Stern, of New York, in 1919 modified the Gerringer operating cystoscope. The Caulk cautery punch, given to the medical profession in 1921, is merely the combination of a cautery device with the Young punch. McCarthy's panendoscope was a most important contribution to the assemblage of urological instruments. His telescopic system has been embodied in numerous devices since it was first designed. It also embodies a cautery feature which was modified by Collings in 1926, the resulting device being called the electrome. Rose's cautery punch was made available in 1928. Still another contributor was F. E. B. Foley, of St. Paul. The most recent modification of which I have knowledge is that of Day, of Los Angeles, which is also founded on McCarthy's work. Others who have worked on this problem are Beer, Stevens, Bugbee, Braasch and Bumpus of the Mayo Clinic, Geraghty, and Mathé.

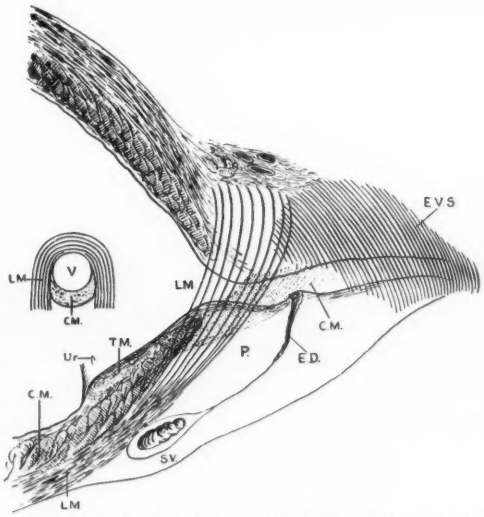

Fig. 5. Sagittal section of adult bladder (diagramatic). "The external longitudinal layer of the base sweeps up over the vesical orifice making a loop. Within this loop the circular layer forms a wedge below the orifice and flows down the urethra in an oblique direction surrounding the canal as a thin layer. The result is a double loop and not a sphincter. The small insert is a cross section of the vesical orifice, showing the upward pull of the loop from the circular muscle and the opposing action of the longitudinal muscle loop. *V.*, vesical orifice; *L. M.*, longitudinal muscle; *C. M.*, circular muscle; *T. M.*, trigonal muscle; *E. V. S.*, external vesical sphincter (striated muscle); *Ur.*, urethral orifice; *S. V.*, seminal vesicle; *E. D.*, ejaculatory duct; *P.*, prostate." (Courtesy of H. H. Young and M. B. Wesson).

ANATOMY AND PHYSIOLOGY OF BLADDER NECK

In order to have any proper understanding of the pathology of median bar obstruction, or to be able to realize the significance of certain changes seen during clinical practice, one must be thoroughly familiar with the anatomy and

Fig. 2. The bladder after the removal of three-quarters of its antero-inferior surface; it is dislocated considerably downward and outward. The blood vessels, as well as the pelvic portion of the ureter have thus, to a certain extent, lost their normal anatomical relations. The right pubovesical ligament is greatly stretched. *1*, Epigastric artery; *2*, umbilical artery; *3*, obturator artery (seen by transparency); *4*, trunk of the superior vesical arteries; *5*, genitovesical artery; *6*, vesiculodeferential artery; *7*, gluteal artery; *8*, anterosuperior vesical artery; *9*, posterosuperior vesical artery; *10*, ascending anterior vesical artery; *11*, inferior vesical artery; *12*, obturator artery (seen by transparency) of anomalous origin; *13*, prostatic artery; *14*, umbilical artery; *15*, anterosuperior vesical artery; *16*, posterosuperior vesical artery; *17*, inferior vesical veins; *18*, vesical branch of the genitovesical artery; *19*, vesical branch of deferential artery; *20*, vesicular artery; *21*, deferential artery; *22*, middle hæmorrhoidal artery; *23*, inferior vesical veins; *24*, genitovesical artery; *25*, vesiculodeferential artery. (After Tsaknis).

Fig. 3. The bladder after section of the lateral attachments and the pubovesical ligaments; it is drawn sharply forward so as to display Santorini's plexus. *1*, epigastric artery; *2*, umbilical artery; *3*, obturator artery, showing abnormal origin of the gluteal; *4*, anterosuperior vesical artery; *5*, posterosuperior vesical artery; *6*, lateral veins of the bladder; *7*, superior vesical trunk; *8*, gluteal artery; *9*, superior layer of the middle aponeurosis; *10*, ascending anterior vesical artery; *11*, obturator artery; *12*, umbilical artery; *13*, anterosuperior vesical artery; *14*, posterosuperior vesical artery; *15*, inferior vesical veins; *16*, inferior vesical veins; *17*, genitovesical veins; *18*, vesiculodeferential artery. (After Tsaknis).

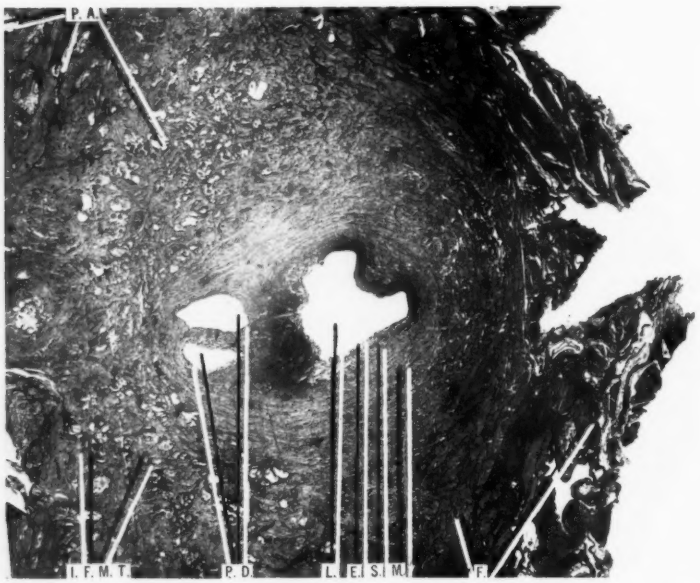

Fig. 6. Section through prostate and urethra. *P. A.*, Prostatic alveoli; *I. F. M. T.*, intra-alveolar fibromuscular tissue; *P. D.*, prostatic ducts; *L.*, *E.*, *S.*, *M.*, lumen, epithelium, stroma, and muscularis of urethra; *F.*, fibrosa with blood vessels of prostatic plexus.

physiology of that portion of the urinary tract most directly concerned. To this subject Young, Lowsley, Watson, Randall, and Wesson have made important contributions. The work of Young and Wesson on the trigone has been especially epoch making. Every member of the medical profession, most of all he who devotes his attention particularly to the urogenital tract, owes them a debt which can hardly be reckoned. While it would be most interesting and instructive to review their work here, the limits of this paper make it impossible. Those desiring more details are referred to the original monographs, which will be found listed in the bibliography.

Blood supply of the vesical neck. Surprisingly little regarding the vascular supply of the vesical neck is to be found in print. Standard textbooks and current literature alike are silent upon what the urologic surgeon cannot but regard as a most important subject. In a careful search I have been able to find but four publications concerned with this phase of vesical anatomy: (1) Fenwick's study of the venous system published in 1884; (2) the paper presented by Keiffer before the Société belge de gynécologie et d'obstétrique, in 1898; (3) Farabeuf's thesis, which concerns the blood vessels of the entire genito-urinary system, completed in 1905; and (4) the only recent work upon the subject—that of Denis Tsaknis, a pupil of Edmond Papin, which appeared in December, 1929. It is noticeable that every one of these authors speaks of the paucity of information upon this very important subject and laments his inability to cover it as thoroughly as it should be covered. Tsaknis especially, emphasizes the need surgeons feel for practical knowledge of the whereabouts of the vessels likely to be encountered when operating in and about the bladder neck. I have, therefore, availed myself of some of the original illustrations of these authors, and am presenting them in colors, so as to emphasize the importance of the various vessels and make their anatomical relations more strikingly apparent. (Figs. 1 to 3.)

SURGICAL IMPORTANCE OF THE VESSELS OF THE BLADDER NECK

Inasmuch as hæmorrhage is one of the chief difficulties to be overcome by the surgeon operating in and about the prostate the practical importance of knowing the typography of the veins and arteries of that region becomes evident.

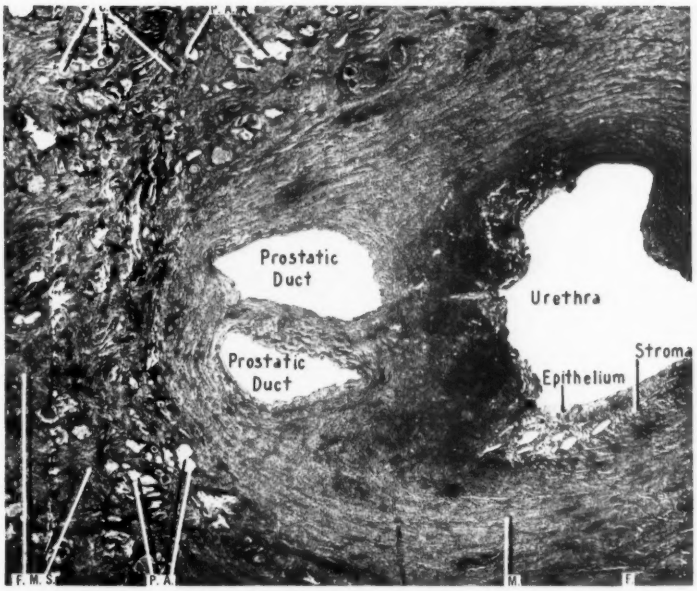

Fig. 7. Section through urethra and portion of prostate gland; *C.*, Concretions in alveoli; *P. A.*, prostatic alveoli; *F. M. S.*, fibromuscular stroma; *M.*, muscularis; *F.*, fibrosa.

Therefore, to the meager information to be found in anatomical and urologic textbooks, it will not be out of place to add the following:

Vesical arteries. All the arteries supplying the bladder have their origin in the hypogastric, though their point of origin varies so much in individuals that it is impossible to lay down any rules. As their course is almost equally variable, it is necessary to exercise great caution before severing any of them, and the wisest plan usually proves to be that of tracing each one to its starting point, though this in many cases will, of course, be quite out of the question. When the arteries have reached the bladder they are subdivided into multiple branches which are customarily distinguished as anterior, superior, posterior, and inferior. These form a plexus from which are given off many tiny arterioles which penetrate the bladder musculature and course through the mucosa, eventually forming another plexus in the submucosa.

The genitovesical artery—so called by Farabeuf—often takes off from the hypogastric in a common trunk with the prostatic artery. It is accompanied by several satellite veins in the first part of its course, but as it nears the lower part, at its crossing of the vas deferens where it is normally separated from the prostatic artery, it becomes so enmeshed in vesical veins that it is at times hard to trace out its arterial branches without actually dissecting them. Arteries, veins, and nerves surround the urethral orifice and the upper third of the urethra, forming what Tsaknis terms *the urethrovascular pedicle.* The artery approaches the bladder at the same angle as the ureter, but before it gains the ureter's point of entrance through the bladder wall it divides into several branches which pass forward and below so as to surround the ureter. If any of these branches chance to approach the bladder at the lower part of its lateral border it is exceptional, and apparently they almost never reach the middle region of its inferior edge. But once the branches have attained the bladder wall they are distributed with fair regularity to the base, the vesical neck, the lower part of the lateral walls, and some to the antero-inferior and posterosuperior walls. A few fine ramifications even reach the seminal vesicles and the prostatic urethra, as well as the prostate itself. The genitovesical artery anastomoses at base of bladder with some branches from the prostatic artery.

In general, it is the inferior arteries which supply the bladder neck and the trigonal region.

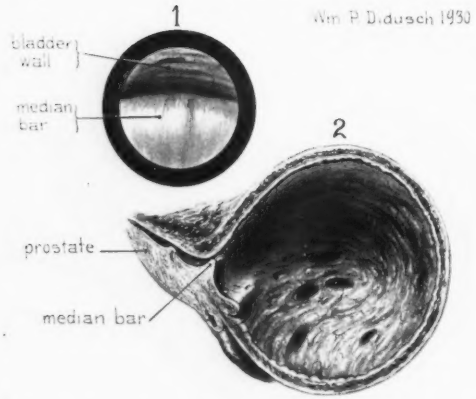

Fig. 8. Type 1, vesical neck obstruction; median bar of dense sclerotic tissue directly across posterior lip of orifice.

They are branches of the genitovesical, anastomosing with offshoots of other vesicular arteries and the hæmorrhoidal branches. Sometimes branches of the vesiculodeferential are directed toward the base of the bladder.

Veins of the vesical neck. The French writers designate the veins by the same titles as those which they apply to the arteries. It is the group called *postero-inferior*, made up of the veins which accompany the arteries covering the posterosuperior surface of the bladder, which supply vessels to the neck of the bladder and the trigonal region. The veins of the posterosuperior bladder wall are visible as soon as the peritoneum is exposed; they all take a downward course but frequently diverge considerably as they descend so as to run off at quite acute angles. At either side they anastomose with the group of lateral veins and those from the vesical plexus. Most of them eventually reach the lower wall of the bladder; thence arrive at the seminal plexus, while a few are likely to be found in front contributing to the formation of the inferior vesical veins. The veins which arise at the trigone and bladder neck flow into the lower stratum of the allantoid sheath, taking a forward and upward course to empty into the seminal plexus in front and into the vesical plexus behind.

As we approach the vesical neck while making an examination of the blood vessels of the bladder wall, it is noticeable that their number and size increase the nearer we approach the trigone. It was observed by Keiffer that those close to the vesical neck became lacunar and cavernous in character, and that the conjunctive tissue below the mucosa was also very rich in vessels. The peculiar richness of the blood supply of this region led him to believe that the phenomenon of micturition is largely brought about by changes in blood pressure, rather than by nerve influences, as is the more common conception.

PATHOLOGY OF VESICAL NECK OBSTRUCTION

Turning now to a consideration of the pathology of median bar hypertrophy we find that this subject has occupied the attention of some of the foremost urologists in this country. Our modern conceptions in regard to it are practically all the result of the work of American investigators, chief among them being H. H. Young and Alexander Randall. Randall studied 28 cases of median bar formation found in the course of 200 routine autopsies. Eight of these bars were very pronounced, but the remainder, though microscopically observable, were early cases in which the bar had not enlarged sufficiently to cause any important degree of obstruction to the outflow of urine, with its inevitable effect upon the remainder of the genito-urinary tract. This author differentiated four types of median bar formation: (1) An abrupt bar or dam of dense sclerotic tissue directly across the posterior lip of the vesical orifice, always associated with a "small sclerotic prostate." (2) A bar growing upward rather than across, encroaching more upon the vesical trigone, so that it tends to cause a transverse fold or crease in the trigonal area. (3) A bar resulting from true glandular hypertrophy originating under the "sphincter muscle," within the prostatic capsule. Even very slight hypertrophy at this point will tend to produce a thick, broad, round edged bar causing obstruction of the vesical outlet long before the hypertrophy of the lateral lobes assumes any importance. This was the type which Randall himself had most frequently encountered. Rare examples of (4) a fourth type of bar formation may be observed. This is due to hypertrophy of the glands of Albarran without hypertrophy elsewhere. It produces, not a bar, but a rounded lobe, and the author found difficulty in deciding whether such formations when discovered in the bar shape should be classed as such—that is, clinically considered—or be grouped with prostatic hypertrophies "which anatomically they are."

In Young and Wesson's 125 cases of hypertrophy of the trigone, they noted a characteristic progression in the development of the condition. The trigone was at first but little elevated above the vesical wall, while the ureteral ridges were

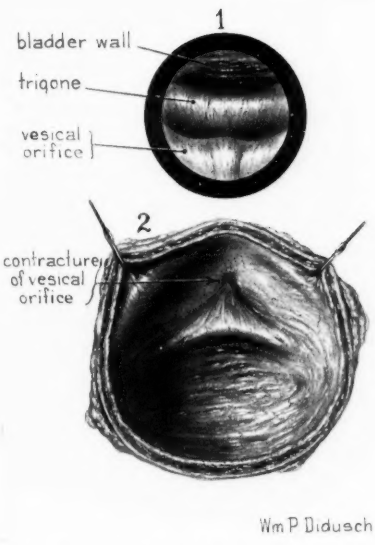

Fig. 9. Type 2, vesical neck obstruction. Bar forming a transverse fold in the trigonal area. Note hypertrophy of trigone.

very definitely raised. In the second stage the trigone had been elevated until it was level with the ureteral ridge, and a shallow cavity was in evidence behind the interureteric ligament. A third stage, wherein the median bar has assumed definite proportions, brings the trigone like a shelf close against the vesical orifice, with the interureteric ridge standing out like a cord with a slight pouch before it, and a deep pocket behind. This is the true Mercier's bar, though this name is often applied to the bar at the vesical neck. In the fourth stage hypertrophy advances much further, the deep pocket is still more profound and may even undermine the trigone so as to dissect it entirely free from the bladder wall and erect it like a dam serving to divide the vesical cavity in two. The process may go on until a large diverticulum is formed.

It should be borne in mind that all the changes which are found in the region of prostate and trigone are dependent upon the existence of inflammation—the final result of some variety of infection which has proliferated in this area at some time or other. Its etiology is, in the last analysis, similar to that of stricture of the anterior urethra. The mucosa of the vesical neck is even better supplied with glands than is that of the anterior urethra. Consequently any inflammatory process will make rapid headway if

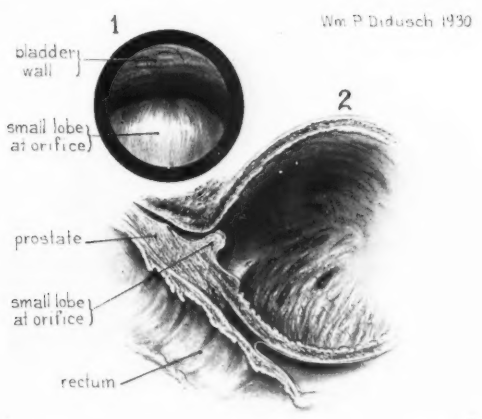

Fig. 10. Type 3, vesical neck obstruction. True glandular hypertrophy, causing a small lobe at the orifice.

once begun in this region. Any condition which will eventually induce prostatic hypertrophy may act in like manner upon the tissues of the vesical neck. This circumstance makes clinical differentiation between the two conditions exceptionally vexatious. We must rely wholly upon cystoscopic observation in making the diagnosis, and as treatment and prognosis are entirely different, the establishment of this distinction assumes great therapeutic importance.

INSTRUMENTS

As our historical review has shown, the attempt to design an instrument capable of dealing with hypertrophy of the median bar preceded by many years any scientific understanding of the condition with which one was attempting to deal. As to the exact nature of the *Trilabe* and *Lithoclaste à écrou*, of Civiale, I am decidedly uncertain. From references in his text they would appear to have been something on the order of the evulsors or dilators still occasionally employed. The instrument originated by Bottini and modified by Freudenberg may properly be accepted as the first of this particular type to be produced. The design of Chetwood's instrument bore some resemblance to that of Bottini and Freudenberg, but it appears to have been productive of far more satisfactory results. Young's first "punch" was a curved posterior urethroscope, with an inner cutting tube, which was later replaced by a tubular cautery in an endeavor to combat the often troublesome hæmorrhage. Young later referred to this early design as "satisfactory but somewhat complicated." With a view to meet-

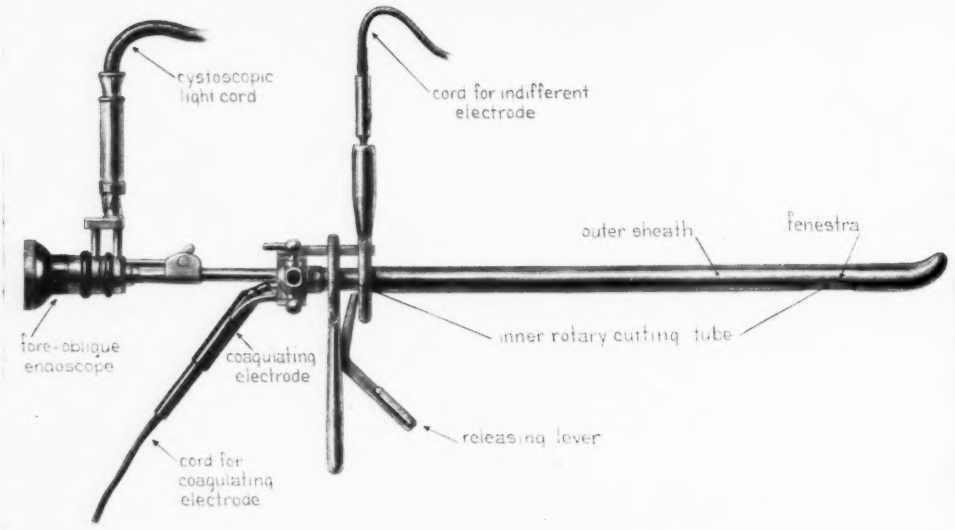

Fig. 11. The assembled instrument.

ing the special problem offered by obstruction in the urethra, Maximillian Stern, of New York, modified the Gerringer operating cystoscope in 1919. His instrument contained a direct vision telescope, a light carrier, and a cannula through which instruments might be passed. The latest addition to this group of instruments is Day's modification of the McCarthy punch, recently described in the *Journal of the American Medical Association*. "With this instrument," we are told, "every advantage of the McCarthy punch is retained with the added insulated needle for preliminary electro-desiccation with a d'Arsonville current."

The vesical neck resector. To present still another instrument when the needs in this respect have apparently been so fully met, requires courage. Yet I feel that the device I am about to describe embodies certain features lacking in all the others, while making it possible for the features of these previous models to attain higher efficiency than even their originators demanded of them. While making no claims to originality, I feel I have succeeded in so manipulating the various parts and supplementing their deficiencies that the completed instrument is more useful than any which have been produced before it. My modifications adapt the instrument I am presenting especially for dealing with vesical neck obstructions; that is, median bar; prostatic middle lobe; contracted bladder neck; obstruction due to post-prostatism, and subcervical gland enlargement.

Up to the present the greatest need in removing median bar obstruction at the bladder neck appears to be a technique which will render the operation bloodless or nearly so. To accomplish this different designers have employed the actual cautery. This is a heating element consisting of a metal blade attached to conductors of electric current of very high capacity. The conducting capacity of the blade itself is low, so that it will be rendered hot as soon as a sufficiently strong current is passed. Whenever this occurs. the hot blade in contact with wet tissue immediately develops steam, scalding the adjacent surfaces, with subsequent scarring and contraction of the mucous membrane.

Replacing the actual cautery by instruments conveying high frequency current does not do away with this danger unless special attention be given to the technique of application. If a small area electrode be used for transmitting the current to the tissues, an arc will form. The arc, being hotter than the cautery blade ever becomes, produces ionization, and this has a toxic effect which is even more injurious than the scalding effect produced by the red hot cautery.

Yet as a moderate high frequency current is quite sufficient to coagulate blood, proper ad-

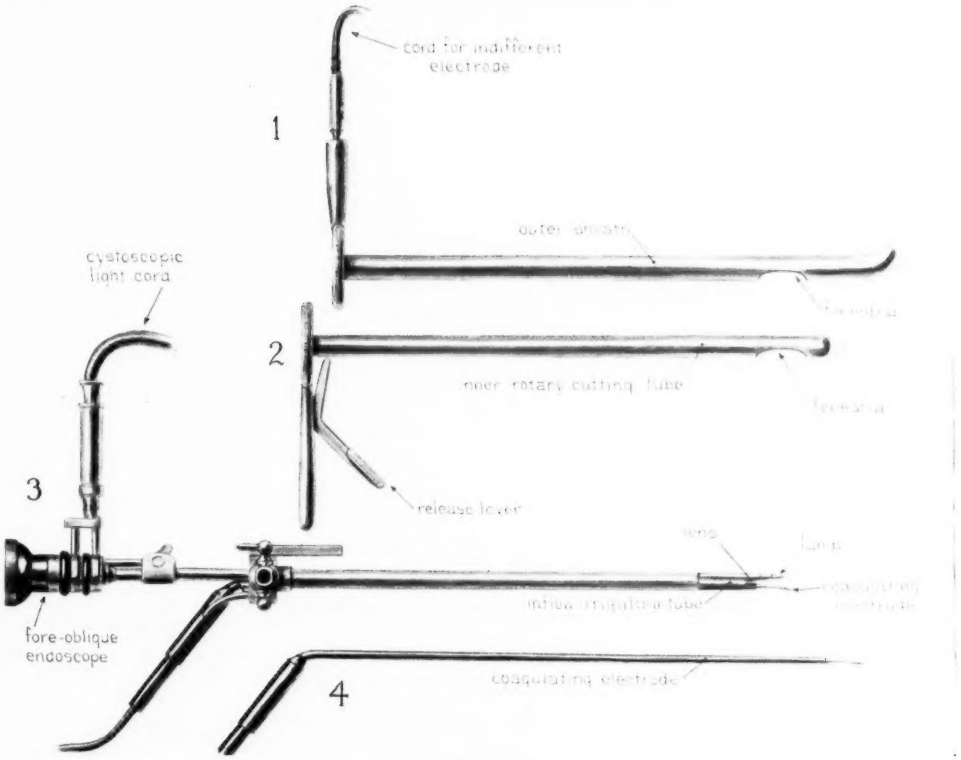

Fig. 12. Instrument dismounted, showing component parts and electric connections.

justment will permit an instrument to accomplish this purpose without ever reaching the scalding point. The blanched area will be a zone of only a few millimeters' extent, directly surrounding the electrode needle. When this has been resected, the cells of the zone about the wound, though heat treated, will still be capable of regeneration and repair, and will show little or no tendency toward cicatrization.

Having in mind these facts in regard to the effect of heat, not alone in producing temporary hæmostasis, but as a source of permanent damage to adjacent tissues, I have designed an instrument for resection of the vesical neck which combines the good points of those which have preceded it, and obviates the drawbacks to which they are subject. To keep the field clear of blood, yet still enjoy freedom of movement with the instrument, the sheath must be without the wicked tooth which characterizes all punch instruments. The fenestrum must be smooth edged and nicely rounded. Water pressure must be provided, enabling one to locate, recognize, and avoid adjacent organs and tissues. Any intruding prominence must be minutely visible. All of these requisites are provided by my instrument. Fixation of any protruding tissue is accomplished by means of a strong electric needle, which at the same time renders the piece bloodless before it is removed. A sharp edged knife is provided to cut off the piece after hæmostasis has been attained by the cautery. This makes it possible to repeat the resecting process as often as the operator wishes, so that everything can be cleared away at a single session. The McCarthy oblique lens system is employed for visualization and illumination.

My instrument consists of an outer steel sheath equipped with a fenestra on one side and a curved beak. An inner tubular structure replaces the usual obturator, which carries the McCarthy lens system, a high frequency needle, and irri-

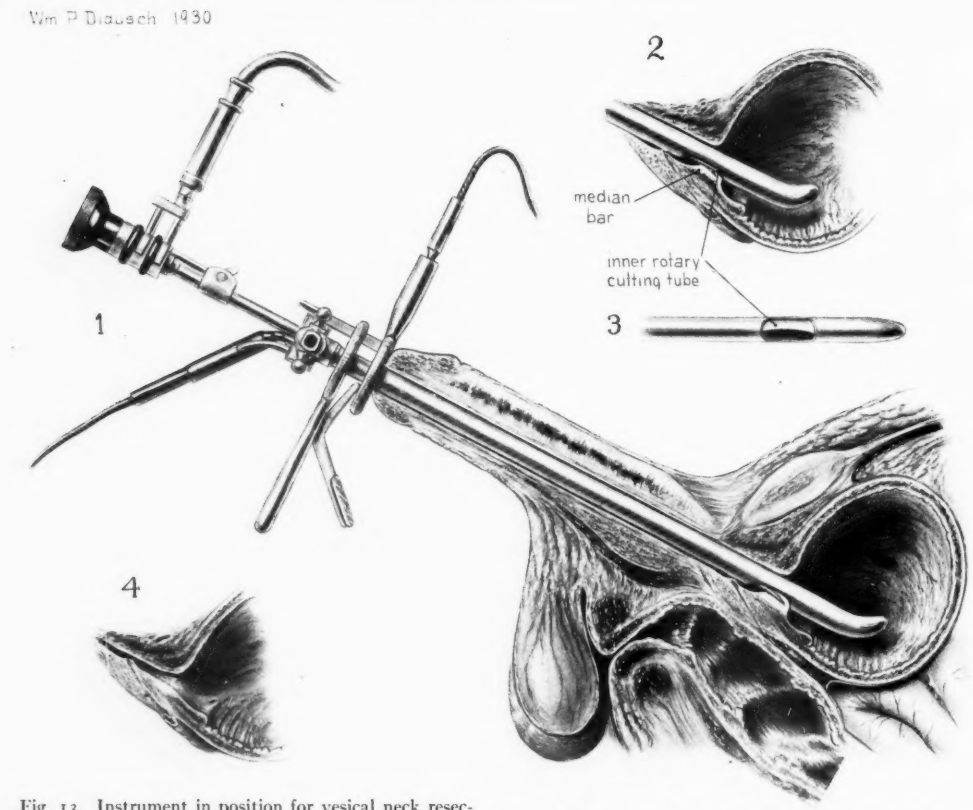

Fig. 13. Instrument in position for vesical neck resection. *1*, Sheath passed through urethra into bladder. Cautery needle point fixes tissue to be removed. *2*, Tissue has been desiccated (indicated by whitening) and is about to be cut off by *3*, the inner rotary cutting tube.

gating cocks. A tubular knife between the two sheaths acts as an obturator, rotating between the two parts previously described. Especially important is this knife which rotates to the operator's right, and thus opens the fenestra. Because its edges are well rounded, the tooth usually found on prostatic punches is unnecessary and has been omitted. This eliminates trauma to the bladder neck while searching for the obstruction. Completely independent of sheath, telescope, illuminator, needle, and irrigating system, the knife can be rotated at will without disturbing or twisting irrigating tubes or cords. At the same time the main instrument has the freedom of motion necessary for exact location of the tissues to be excised, the site of which the preceding cystoscopic examination has determined.

Operation with this instrument is generally done under caudal anæsthesia. For operators who do not employ this method, and for cases in which it is inadmissible for any reason, I have provided an electrode equipped as a Luer needle. With this, novocain can be injected directly to the area where section is to be done.

The obstructing tissue having been located and anæsthetized (if caudal anæsthesia is not used), it is firmly fixed by the needle electrode and desiccated under low heat (about 30 seconds). It is then resected by rotating the tubular knife and the resected tissue withdrawn by removal of the knife and the inner tube with its attachments, leaving the outer sheath in the urethra. By pressure of the thumb lever any binding at the fenestra is overcome, as the possibility of rotation while pulling obviates jerking and trauma. The section of tissue may be removed, the needle adjusted, etc., and the knife and tube reinserted for further resection as many times as is found

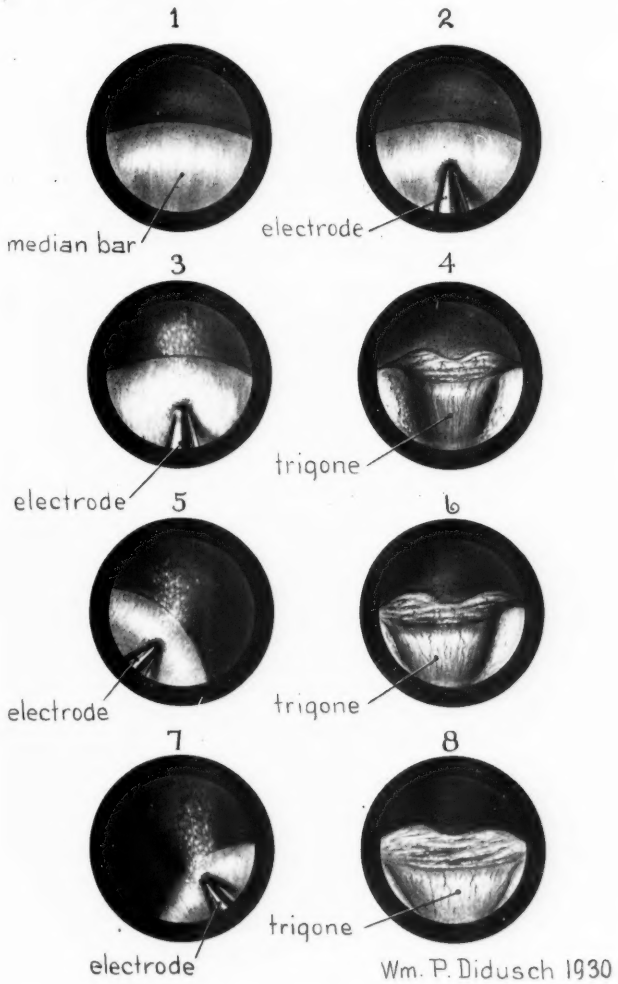

Fig. 14. Resection of vesical neck obstruction. *1*, Median bar of dense sclerotic tissue. *2*, Needle electrode applied to center of bar. *3*, Desiccation of tissue indicated by whitening. *4*, Trigone exposed by first excision. *5*, Needle electrode applied at one side of bar. *6*, Further exposure of trigone. *7*, Needle electrode applied to opposite side of bar. *8*, Trigone in full view after three cuts have been made with rotary cutting blade following desiccation of tissue.

necessary. The electric needle and the sharp knife edge serve to engage the instrument firmly in the tissue, so that we actually get larger sections, while the lateral, instead of the customary longitudinal, punch also prevents the pushing out of the greater part of the engaged tissue, often vexatious with other instruments of this type.

Throughout the procedure the operator must exert continuous downward pressure upon the instrument. This is highly important. Otherwise, the protruding mass might not fill the fenestra so as to be held firmly for transfixion with the electric needle. After desiccation the tissues are extremely friable, and if the mass is

not held firmly, the needle will break away—that is, transfixion will fail, and when the knife is rotated there will be nothing to be cut off.

AFTER-TREATMENT

Following resection, a No. 20 or 24 F. soft rubber catheter is left in the bladder for 24 to 48 hours. During this period irrigations of mild boric acid solution should be given. About 2 weeks after operation the bladder neck should be dilated with a No. 24 to 28 F. sound. A slight loss of control may be present during this period, but continence will be re-established within a few weeks.

Cystoscopy should always precede operation with this instrument. The fenestra must remain closed during insertion to avoid any possible trauma to urethra and vesical neck. The bladder being filled with sterile water or boric acid solution, the instrument is passed to it and the fenestra opened by merely turning the handle. The collar outside the tubular knife is marked to indicate whether the fenestra is open or closed. After desiccation of the tissue, the needle remains embedded in it, thus preventing its slipping upon application of the knife. If any fibers remain unsevered after the rotary cut is made, they will be separated by the sliding of the knife from the sheath during withdrawal.

If it is desired to employ the instrument as a regular type of punch, the sliding motion is available for that purpose, being from within outward.

By the employment of this instrument a major operation is reduced to a procedure of minor importance, accomplished with a minimum of bleeding and discomfort to the patient. The routine is easily acquired by anyone familiar with cystoscopic technique. It should prove convenient and efficient to any qualified operator.

CASE REPORTS

From the 25 to 30 cases in which the instrument has so far been used, the following have been selected as illustrative of its adaptability. All of these patients have been benefited by the operative measure; frequency has been lessened; and a general systemic improvement noted, due, no doubt, to relief from bladder retention and the intoxications remotely traceable to it.

Case 1. Patient of Dr. O. S. Lowsley. He was 39 years of age and gave a history of frequency and nocturia for preceding 3 years. Cystoscopic examination showed a definite median bar obstruction. The vesical neck resector was inserted and three cuts were made. There was no bleeding and the postoperative results were excellent. The greatest rise in temperature was to 100.6 degrees, and the catheter was withdrawn on the second postoperative day.

Case 2. Hosp. No. 292099. Patient, aged 65 years, had suffered from frequency and nocturia for upwards of 3 years, with hæmaturia at times and one attack of acute retention. Upon examination the residual urine was found to amount to 4 ounces, while the cystoscope showed definite median bar obstruction. Three cuts were made with the vesical neck resector, followed by very slight bleeding, but nothing which could be designated as hæmorrhage. The catheter was removed on the second day, the temperature never rising above 99.6 degrees throughout convalescence. The patient remained under observation because of suspicion of vesical carcinoma.

Case 3. Hosp. No. 292945. Patient, aged 79 years, had symptoms of increasing frequency both by day and by night which had been observed during a 5 year period. There had been operative interference at another hospital 2 years ago, followed by improvement which had persisted until about 3 weeks before his coming under the author's care. The cystoscopic examination at once revealed prostatic hypertrophy, but as the patient refused prostatectomy an effort was made to relieve him by use of the vesical neck resector. Three cuts with this instrument afforded him apparent relief; there was no hæmorrhage, and the catheter was removed on the second day. On one occasion the temperature rose to 102.4 degrees, but convalescence was on the whole satisfactory, with disappearance of the previous symptoms of obstruction.

Case 4. Hosp. No. 293175. Patient, aged 62 years, had a vesical calculus, with evident prostatic enlargement on cystoscopy. For a period of 3 months he had been experiencing pain at the termination of urination, with increasing frequency, hæmaturia, and nocturia. There was a residual of from 5 to 10 ounces. The bladder neck was much contracted and three cuts with the vesical neck resector were required to open up the obstruction. There was no bleeding, either during or following the intervention, and the temperature reached 101.4 degrees on one occasion only.

Case 5. Patient of Dr. F. P. Twinen. He was 57 years of age and gave a history of frequency and nocturia of 3 years' duration. The residual urine measured from 2 to 11 ounces. Cystoscopically there was pronounced median lobe enlargement. Three cuts were made with the vesical neck resector, and upon the specimens secured the pathologist reported chronic cystitis with a suspicion of vesical carcinoma. The patient has been much relieved by the instrumentation, but remains under observation.

Case 6. Patient of Dr. Twinen. He was 58 years of age and gave a history of frequency which had been in evidence for 6 months; there had been two attacks of complete retention, but on measurement of the residual it was found seldom to exceed an ounce. There was a moderate prostatic hypertrophy, and following the employment of the vesical neck resector, the specimen was reported as showing inflammatory fibrosis and cellular infiltration. The results of the use of the instrument were excellent, with but very slight bleeding for a short time after intervention.

SUMMARY AND CONCLUSIONS

The advantages of the vesical neck resector described are:

1. The absolute elimination of the profuse hæmorrhage always heretofore produced by instruments of this type—a most important feature.

2. The possibility of definitely regulating the amount of heat applied. Slow desiccation of the

blood vessels eliminates sloughing which is prone to occur following the use of high temperature uncontrolled and with no method of determining how deeply the tissues are being seared.

3. The fact that the circular knife cuts in the direct contour of the bladder neck. This is a very great advantage, but if the operator still prefers an instrument of the punch type, this resector is equipped to cut longitudinally, from within outward. The circular cutting type is nevertheless to be preferred.

4. Vision is never at any time obscured. The operator can *always* see what he is doing. The vesical neck is always visible because it is continuously dilated by the constant irrigation. This is far superior to a method which depends upon the instrument itself for dilatation.

5. The lateral position of the knife makes possible the cutting of a larger section. The fenestra differs from any previously designed in that all sharp edges and protuberances have been done away with, permitting free motion while searching for the vesical neck obstruction, without danger of traumatizing adjacent tissues.

6. The needle which pinions the obstructing tissues permits fixation of the part to be operated upon, so it may be readily engaged. Slipping of the tissue under the knife has been one of the worst faults of most instruments of this type, often making clean cutting difficult or altogether impossible.

NOTE.—In closing it is my great pleasure to acknowledge the friendliness and courtesy of Dr. Lowsley and the entire personnel of the James Buchanan Brady Urological Department of the New York Hospital; as well as of Doctors Deming and Vermooten, of Yale, and my New York colleagues, Doctors Sturdivant Read, Barringer, Dean, Valentine, Twinen, DeVries, and Duff, who permitted me to make practical demonstrations of this instrument upon their patients. I would pay tribute also to the artistic attainments of Mr. William Didusch, by whose masterly work I have greatly profited. But my greatest debt of all is to Mr. Reinhold Wappler. Without his skill, persistence, and unrivaled mechanical ingenuity, my ideas would never have attained concrete form.

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MAKING AND CLOSING OF ABDOMINAL INCISIONS[1]

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SUITABLE incisions afford adequate exposure for intra-abdominal operations, permit the margins of the wound to be protected against avoidable injury and contamination during operation, may be elongated if necessary, and can be so closed as to promote sound healing, prompt recovery of function, and thus warrant early reactivation of patients.

Detailed requirements are:

1. Immediate separation of the layers to be approximated in closure;

2. Immaterial impairment of the circulation of blood and lymph in any layer;

3. No transection of muscles;

4. Transient, if any, interference with transmission of motor, tonic, and sensory nerve impulses;

5. Elimination of forceful retraction during operation;

6. Sound serosa-to-serosa closure of peritoneum and accurate approximation of properitoneal fascia to limit the inevitable formation of adhesions between omentum, viscera, and parietal peritoneum to the line of closure (1) and to prevent separation of margins during the period of healing or the stretching thereafter which so frequently inaugurates hernia;

7. Replacement or approximation of muscles over the sutured peritoneum to afford the support needed for immediate protection and to prevent subsequent development of hernia;

8. Sound closure of the deep fascia to re-enforce (6) and (7);

9. Approximation of the deep layer of the superficial fascia to foster healing of the fat and to prevent the skin from becoming adherent to the deep fascia;

10. Skin margins approximated accurately but not so snugly as to prevent escape of serum and lymph;

11. Provision of separate pathways for drains so as to conform with (2), (3), and (4);

12. Utilization when indicated of stay sutures to relieve the tension in the structures and sutures in (6), (7), and (8), thus preventing their separation and partial or complete extrusion of viscera.

Paramedian, median, and gridiron incisions will fulfill these requirements if selected with regard to the nature of the intra-abdominal operation and the anæsthetic[2] to be employed, if made long enough to obviate the need of forceful retraction and if finesse be substituted for brute strength.

PARAMEDIAN INCISIONS

Skin, fat, and fascia are incised over the middle of a rectus muscle. The mesial margin of the fascia is elevated and dissected from the underlying muscle (Fig. 1). No nerves and few vessels are injured. Muscle (protected by moist warm gauze) is retracted laterally and the peritoneum is incised (Fig. 2).

Approximation of the peritoneum before suturing is obtained by application of forceps of the Kocher type to its margins, crossing them alternately, and exerting gradually the necessary amount of counter traction. The line of traction is not horizontal as indicated in the illustration (Fig. 3), but is upward as well as lateral. Thus the parietal peritoneum is sufficiently separated from the viscera and omentum so that the insertion of sutures under direct vision can be accomplished without danger of including deeper structures. It is usually convenient to insert a finger to depress the omentum as the stitches are introduced, thus providing absolute protection. A continuous mattress suture begins at one angle, and each stitch is pulled snugly, thus shortening the length of the incision (Fig. 3). It is locked at the opposite angle and continued back as an over-and-over stitch to approximate the properitoneal fascia and is tied to the end of the first mattress stitch (Fig. 4). The rectus muscle is replaced and anchored with a few stitches (Fig. 5). The rectus fascia is closed as represented in Figure 6 or, preferably, by a suture quite identical with that illustrated in Figures 3 and 4. Insertion of the continuous mattress stitch can be accomplished by everting the margins of the deep fascia thereby avoiding further separation of fat from fascia and injuring this poorly healing tissue. The mattress portion of the stitching, stay-like in its effect, provides relaxation of the margins which can then be approximated nicely with the over-and-over portion. Approximation of the deep layer of the superficial fascia with interrupted stitches of fine catgut is not illustrated. The skin may be closed any way

[2] Difficulties in obtaining exposure are increased by incomplete relaxation of the abdominal muscles. Their contraction is intensified by forceful retraction and intra-abdominal manipulations. In consequence closure becomes more difficult. Indeed, satisfactory closure may be impossible, and the likelihood of postoperative paresis or paralysis of the gastro-intestinal tract is great. Hence a preference for deep ether narcosis and spinal anæsthesia because the relaxation obtained by the local gas, or combined gas and local anæsthesia as usually administered is less than required by the average operator.

[1] Presented at a meeting of the Chicago Surgical Society, April 4, 1930.

if not too tightly. A satisfactory suture is indicated in Figure 7.

Postoperative separation of the margins of recent incisions is caused by traction exerted upon the sutures and the tissue included in them in consequence of increased intra-abdominal pressure (distention, vomiting, coughing, sneezing, often combined) and by unusual tension exerted by the lateral muscles rendered hypertonic from pain, peritoneal irritation, or in resistance to increased intra-abdominal tension. Separation is caused more frequently by the tearing of the tissues than by disruption of the sutures. Whatever the cause of the separation, it can not only be obviated but the blood supply of the sutured structures can also be preserved if tension upon them is prevented. A means has been found to accomplish this prevention by applying the principle devised by Shipley for the re-closure of separated incisions.[1]

Sutures are passed, by means of a long straight Hagedorn needle, from within outward (Fig. 7). They include the margins of the deep fascia mesially and a bite laterally and are sufficiently long to make the line of tension tangential so as to obviate a cutting pressure upon the fat and skin. They are inserted through felt pads and then through stitch apertures in buttons. Manual pressure is applied to the sides of the abdomen so as to relax the structures along the line of closure. The tension sutures are pulled up snugly enough to maintain this relaxation and are fixed.

Experiments upon animals conducted at Columbia Hospital and limited clinical observations indicate that these tension sutures need not be double as illustrated, that bronze wire is superior to silver wire, and that heavy (waxed ?) silk may be the best. The method seems to be efficacious. Relaxation of the sutures as convalescence progresses is desirable if they cause distress or induce local irritation. If the skin beneath the felt pads is cleansed daily with alcohol, the sutures may be retained for 14 days without serious damage, and by that time patients are walking and the danger of separation of the incision is passed.

[1] We have tried to employ stay sutures of stained and unstained silkworm gut in every possible way as simple loops, single and double figures of eight, tied loosely and snugly, with and without including gauze between suture and skin. The cutting capacity of silkworm gut is superior to some scalpels, its irritation of skin exceeds that of other suture materials, possibly excepting horse hair. If the sutures be tied too snugly, they cut through tissues, including skin. If they be tied too loosely, they are not even good setons. If they be tied neither too snugly nor too loosely, they do almost no harm but little good. Every surgeon has seen disruption of wounds properly closed with silkworm gut stay sutures. Most wounds closed without stay sutures will not disrupt. There is a popular superstition among operators that the introduction of silkworm gut stay sutures contributes to the failure of such wounds to disrupt. Surgeons appreciate facts and welcome the principles established in Shipley's ingenious contribution.

A small proportion of abdominal wounds require stay sutures to provide satisfactory healing. Their utilization is indicated if patients are deficient in stamina or in capacity to form fibrin, if the tissues of the individual are unusually friable, if distention is present or is likely to develop, and if retraction of the parietes during operation makes closure difficult, and unwholesome tension upon tissues and sutures is immediate.

Figure 8 shows the re-closure of a separated median suprapubic incision as advocated by Shipley. The adhesive plaster was applied to approximate skin and still permit egress of secretions. Figures 9 and 10 show stay sutures introduced at operation to prevent separation of a median suprapubic incision. The forward bulging of the abdominal wall between the buttons, indicating the relaxation provided, had been maintained for 7 days when the photograph was taken and persisted for another week when the stay sutures were removed (Fig. 10). Adhesive plaster had been applied to retain approximation of the skin after its sutures had been removed on the second day. Figure 12 illustrates the utilization of stay tension sutures to prevent separation of a paramedian incision and to warrant earlier safe activation of an obese patient who was deficient in stamina. Ends of bronze wire stay sutures had been left long so that they might have been brought together over the wound dressings if additional support became necessary and thus make it safe to pull them but moderately taut when the incision was closed. They were retained a fortnight without causing distress or inducing more than superficial irritation. Figure 13 shows single stay sutures of waxed silk used to protect a left paramedian incision made to remove the spleen from an 8 year old boy much weakened from fulminating thrombocytopenic purpura. The photograph was taken the fifth day after operation. All stitches had been placed unusually close together to prevent oozing. This is indicated by the button-hole sutures in the skin. Dark areas about the incision were subcutaneous hæmorrhages that occurred despite meticulous ligation of vessels. A mild infection developed in the fat and extended to the left along the middle stay suture which was removed on the tenth day. Recovery was otherwise uneventful.

MEDIAN INCISIONS

Both suprapubic and infrasternal forms may be preferable to paramedian incisions if it be desirable in addition to an intra-abdominal procedure to correct an epigastric or an umbilical hernia or a wide diastasis of the rectus muscles.

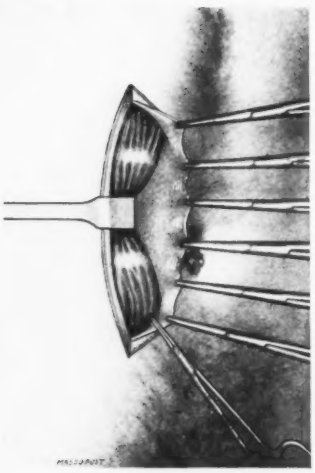

Fig. 1.

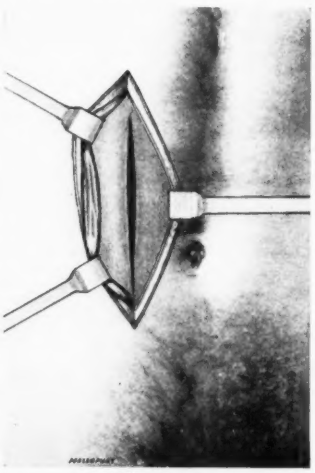

Fig. 2.

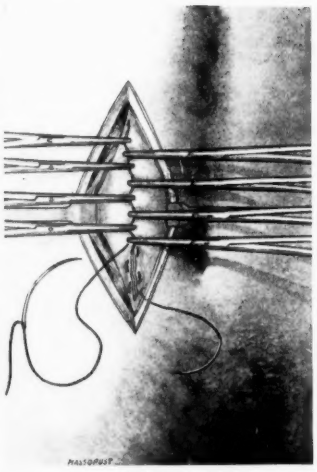

Fig. 3.

Fig. 1. Paramedian incision. Skin, fat, and fascia incised over middle of a rectus muscle. Mesial margin of fascia elevated and dissected from underlying muscle. Few vessels and no important nerves are injured. Muscle (protected with moist warm gauze) is retracted laterally.

Fig. 2. Paramedian incision. Peritoneum incised at, or lateral to, the middle of the rectus muscle so that the line of subsequent closure will not be too near the linea alba. If exposure proves inadequate, the incision may be extended in either direction without jeopardizing early restoration of function.

Fig. 3. Closure of a paramedian incision. Approximation of peritoneum obtained by application of forceps to its margins, crossing them alternately and exerting gradually the countertraction required, not so horizontally as illustrated, but forward as well. Insertion of the first row of stitches, a continuous mattress suture, begins at either angle under direct vision. Depressing the omentum and viscera by inserting a finger beneath the peritoneum facilitates sewing and affords absolute protection against including them in a stitch. When the peritoneum is closed by uniting serosa to serosa the last mattress stitch is locked.

Exposure of the pelvic viscera in women is the common requirement and diastasis of the rectus muscles is usual in multiparæ and frequent in nulliparæ. It is often necessary to excise the umbilicus (Fig. 14) to provide a satisfactory closure.

Peritoneum is approximated and sutured as illustrated in Figures 3 and 4. The mesial borders of the rectus muscles are united with interrupted stitches (Fig. 15). In closure of the rectus fascia imbrication is desirable if feasible in order to add support to the approximated rectus muscles by reducing the size of the rectus sheath and to secure firmer healing. Closure of fat and skin and insertion of stay sutures have been described and illustrated.

GRIDIRON INCISIONS

Criticisms of lateral muscle-splitting incisions upon the grounds that obtainable exposure is sometimes too limited and that injury to nerves is frequently unavoidable are but partially justified. If the level of separation of the fibers of the internal oblique and transversalis muscles is adapted to the position and course of the twelfth thoracic and hypogastric nerves (Fig. 16), they may be mobilized and displaced without injuring them permanently. Thus the peritoneum can be exposed widely, and, if this proves inadequate. the rectus fascia can be incised as introduced by Harrington and Weir and the lateral border of the rectus muscle retracted mesially (Fig. 17). The additional exposure provided permits gridiron incisions to be employed in the great majority of operations for which it is suited, notably appendectomy, for which it was devised by McArthur though first published by McBurney.

Accurate approximation of layers in the closure of these incisions is requisite to promote satisfactory healing, although healing will occur if only the peritoneum is sutured.

Peritoneum is approximated by the use of forceps (Fig. 3) and sutured with a continuous mattress suture. If the rectus sheath has not been incised, the forceps used to provide approximation of the peritoneal layer are tilted, after the mattress suture is completed, away from, instead of toward, the opposite margin and the ends of the suture are tied around them, thereby reducing the closure from a line to a point. If the wound has been enlarged, each stitch in the continuous mat-

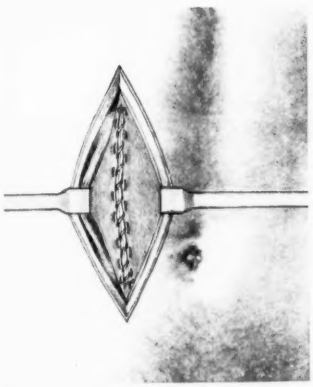

Fig. 4.

Fig. 4. Closure of a paramedian incision. When the peritoneum has been completely reunited by serosa-to-serosa approximation, the last mattress stitch (Fig. 3) is locked and continued as an over-and-over suture to appose the everted margins of the peritoneum below Douglas' fold and the transversalis fascia above it. It is tied to the end of the first mattress stitch.

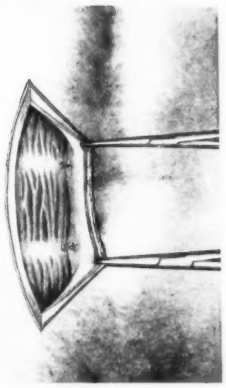

Fig. 5.

Fig. 5. Closure of a paramedian incision. Rectus muscle is replaced and anchored with a few stitches, particularly at tendinous insertions.

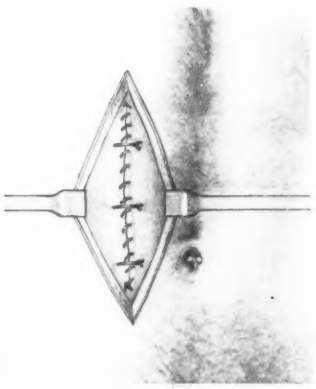

Fig. 6.

Fig. 6. Closure of a paramedian incision. Rectus fascia may be repaired with a simple over-and-over stitch reinforced, if necessary, with a few interrupted sutures.

tress suture is pulled snugly, thus puckering the everted margins and reducing the length of the line of closure. Approximation of the transversalis muscle hastens repair and restricts exudation. The internal oblique should be united so that the anterior surface is accurately apposed in order to limit adhesions to the under surface of the external oblique (Fig. 18). Imbrication of the margins of the fascia of the external oblique assures the stronger reunion of surfaces instead of edges. Interrupted stitches of fine catgut suffice and must not include nerves. Closure of superficial layers has been described.

DRAINAGE

Drains are foreign bodies employed to provide a prompt formation of adhesions between contiguous structures in order to exclude a dangerous area from the balance of the peritoneum (6) and to provide an extraperitoneal outlet for the serous and other exudates that will form within it and the secretions (bile, urine, intestinal contents) that may enter it. They may be utilized prophylactically (e.g., after cholecystectomy, suture of intraperitoneal rupture of the urinary bladder, hysterectomy, intestinal resection), hæmostatically (removal of an enlarged adherent spleen), or after opening an intraperitoneal abscess.

Whatever the reason for drainage, the amount of foreign body introduced should be restricted, so far as safety permits, and should consist of units that may be withdrawn successively to allow the tract to collapse and finally to close from the bottom. The units should if possible be soft and smooth and if gauze is required to check hæmorrhage all but the portion in contact with the bleeding surface should be enveloped in protective guttapercha. The intraperitoneal portion, so far as possible, should be surrounded with omentum, particularly as it enters the parietal peritoneum.

The only serious problem is how to place drains in the parietes in reference to the type of incision that has been employed and the reason for drainage. Prophylactic drains are small and may, if a median incision is used, be brought out through an angle thereof. If paramedian or gridiron incisions be used it is wise to make an additional lateral stab incision for the drains. So too hæmostatic drains are provided with a separate channel. A lateral stab opening is but a limited gridiron incision made by a short cut in the skin, in the deep fascia in line with the direction of its fibers, blunt separation of the muscles, and pushing the forceps through the parietal peritoneum. The tract is stretched by opening the forceps and the ends of the drains, already placed, are grasped in the forceps and pulled out through the skin until taut.

Drainage of abscess cavities depends upon the character of the infection and again upon the type of incision as well as upon how effectively it has been protected from contamination during operation. If the abscess has been provoked by the ordinary pyogenic organisms or by tubercle bacilli, the same procedure as indicated in establish-

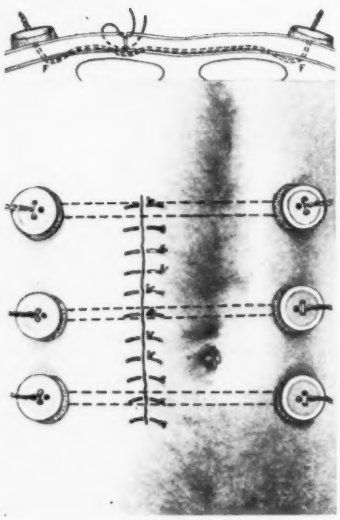

Fig. 7.

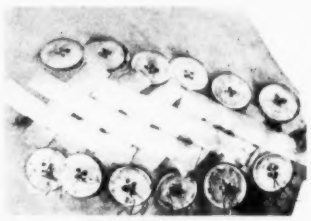

Fig. 8.

Fig. 9.

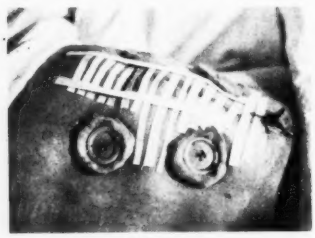

Fig. 10.

Fig. 7. Closure of a paramedian incision. A satisfactory type of interrupted skin stitch is indicated in the drawing and in the diagram above it. The stay sutures, also indicated in drawing and diagram, illustrate the method of using them when the parietal structures are thin and friable. A single suture of heavy silk is preferable to the wire shown in the illustration and so arranged that the buttons are more nearly equidistant from the incision.

Inclusion of deep fascia as indicated at FF in the diagram is needed only when the skin and panniculus of thin patients fail to offer sufficient resistance to traction exerted by the sutures and buttons.

Fig. 8. Reclosure of separated median suprapubic incision with silver wire and buttons as advocated by Shipley.

Fig. 9. Stay sutures used to prevent separation of median suprapubic incision employed to remove carcinomatous uterus. Forward bulging of parietes between buttons indicates relaxation of parietes maintained for 7 days. Adhesive plaster strips had been applied on the second day after skin stitches were removed. Cigarette drains in lower angle allowed to remain because bloody ascites was present at operation and drainage had not ceased.

Fig. 10. Lateral view of same patient shown in Figure 9.

ing prophylactic drainage may be employed. No matter how carefully the margins of the operative incisions be protected some contamination is unavoidable. Subsequent infection is less certain to develop if the amount of catgut used in closure is reduced to limits of safety and will be less disastrous if interrupted stitches be employed instead of continuous sutures. Although stay sutures are undesirable they may be imperative save in gridiron incisions. The skin should be loosely approximated, preferably with adhesive plaster.

Presence of the anaerobic gangrene producing bacteria in the abscess is a threatening complication which usually can be detected by the peculiar odor. Infection of the incision is quite inevitable and will produce necrosis, particularly of fat and fascia. These anaerobes are with rare exceptions present only in periappendicitis. Should a gridiron incision be employed, it is safe to place the drains in the opening and close it loosely if at all. A hernia is likely to develop no matter what is done; sutures and making an additional incision for the drains only add to the extent of tissue destruction. If a paramedian incision is used it is wise to make an additional lateral stab incision so as to bring the drains out most directly through the parietes and thus limit the intraperitoneal reactions, even though the operation incision is going to become infected. This, be it noted, is an argument in favor of using a gridiron incision routinely in operations for appendicitis, especially if an abscess be present.

In brief, the principles that govern the institution of drainage are the same as those that control the making of abdominal incisions. They differ in that drainage openings are allowed to close spontaneously.

EXPERIENCE

Median, paramedian, and gridiron incisions have been employed for 15 years. The (1) exposure during operation, the (2) amount of retraction required, the (3) opportunity to keep the margins of the wound covered with moist warm gauze, the (4) ease and safety of elongating the original incisions, (5) method of repair, (6) immediate healing, (7) rapidity of recovery of function, (8) avoidance of hernias, and (9) the prospective intervals of inactivations have been studied.

1. The extent of exposure required, dependent as it is upon the relaxation provided by the anæs-

Fig. 11.

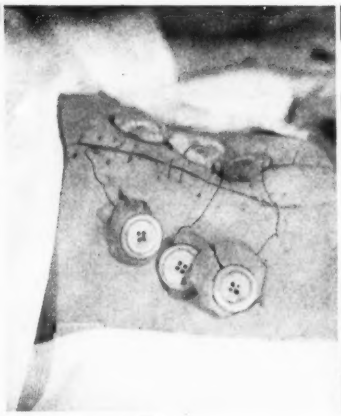

Fig. 12.

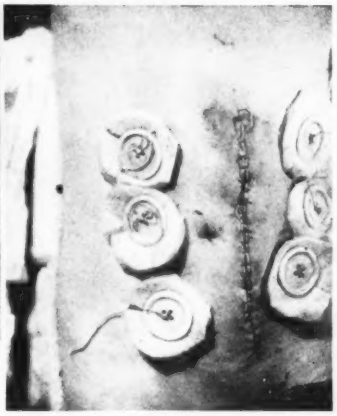

Fig. 13.

Fig. 11. Same patient shown in Figures 9 and 10 on the fifteenth day after stay sutures had been removed Cutting of skin by wire sutures, though avoidably extensive, caused little distress. Tension upon sutures was needlessly high.

Fig. 12. Stay sutures used in closure of paramedian incisions, but less tension employed than in previous patient. Ends of bronze wire sutures left long to be brought together over wound dressings if it became necessary to provide additional support. These sutures were retained for a fortnight without causing distress and induced only slight superficial irritation.

Fig. 13. Stay sutures inserted to support a left paramedian incision made for splenectomy because of fulminating thrombocytopenic purpura. Dark areas about incision are subcutaneous hæmorrhages that occurred despite efforts to produce hæmostasis. Ends of single waxed stay suture left long so they could be tied should distention occur.

thesia, the nature of the intra-abdominal lesions, the thickness of the abdominal wall and the adroitness of the operator, is commonly underestimated. Based upon the fact that a long incision properly made and closed heals as rapidly and as soundly as a limited incision, it is certain that an incision just long enough is usually a little too short. It is unrecorded that the performance of an intra-abdominal operation accurately, thoroughly, and gently was ever prevented by a too easy approach.

2. Wider exposure reduces the amount of retraction required, and the less the retraction the less the contraction of the lateral muscles which, in addition to tympanites, is the main obstacle to obtaining a satisfactory closure.

3. Keeping the margins of the wound warm and moist, protecting them from chemical irritation, bacterial contamination, and at the same time minimizing the trauma from retractors, facilitates healing but requires longer incisions.

4. Elongation of median and paramedian incision without jeopardizing healing materially is limited by the length of the rectus muscles. Elongation of gridiron incisions suffices to permit removal of appendices though they be adherent in the pelvis. Rarely a long appendix adherent to cæcum and ascending colon can not be removed safely through the original incision, but can be exposed adequately if another similar incision be made at a higher level after the skin and external oblique are retracted upward.

5. Methods for suturing the layers exposed by the three incisions have varied with untoward experiences and transient superstitions. The facts are clear. Some contamination of every wound is inevitable and is consequential only when the virulence of the bacteria exceeds the resistance offered by the tissue upon which they have been deposited. This resistance is augmented to an even greater degree by the blood delivered to these tissues. Consequently, if structures exposed are shielded from injury and are so closed that they retain an effective blood supply, the amount of suture material needed to effect a sound closure can be used without detriment to healing. Should the virulence of the contaminating bacteria be excessively high, infection is inevitable, and if this be known, closure should be modified and drainage instituted so as to make the effects least disastrous. The problem of stay sutures awaits a solution that time and experience will ratify. At present it is evident that the requirements for a satisfactory solution are to prevent tension upon the tissues united by sutures, to preserve an adequate circulation of blood and

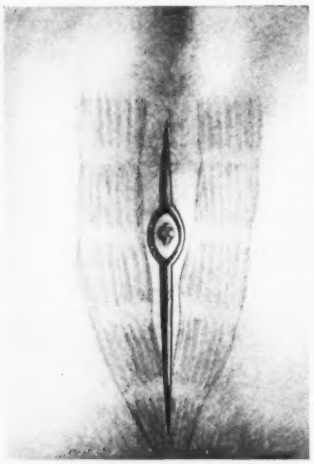

Fig. 14.

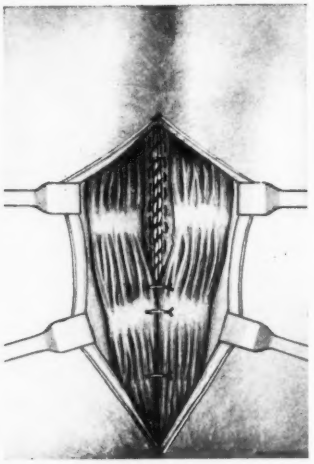

Fig. 15.

Fig. 14. Median suprapubic incision. Incision made to remedy diastasis of recti muscles as well as to provide wider exposure.

Fig. 15. Closure median suprapubic incision. Combined continuous mattress and over-and-over sutures used to close peritoneum and the transversalis fascia above Douglas' fold. Recti muscles being approximated with interrupted sutures.

lymph within them, and to interfere immaterially with the transmission of nerve impulses to and from them.

6. Immediate healing has been less unsatisfactory than when other methods were employed. Limited subcutaneous accumulations of serum occur perhaps too frequently. Disintegration of fat, sometimes accompanied by a mild infection, is occasional. Sloughing of the deep fascia is unusual and has been significant only in prolonging convalescence.

In one patient, an obese physician who had a gangrenous cholecystitis and an acute appendicitis with an abscess which contained anaerobic bacteria, the rectus muscle sloughed completely after a paramedian incision.

In one patient, from whom a strangulated ovarian cyst had been removed through a median suprapubic incision and silkworm gut stay sutures were employed in closure, the wound, because her sutures cut loose from coughing, disrupted on the seventh day. Her abdomen was re-closed (Fig. 8) as advocated by Shipley and she recovered. Disruption of the wound in another patient occurred on the fifth day from tympanites and vomiting after cholecystectomy and appendectomy. A paramedian incision had been employed and no stay sutures were used in closure. Re-closure of the wound and a jejunostomy failed to prevent death from paralytic ileus. A suprapubic incision which was closed with silkworm gut stay sutures disrupted, when the patient coughed, on the eight day after a tuberculous uterus had been removed. The wound was resutured and the patient recovered. Gridiron incisions employed to correct peri-appendicular abscesses that contain chiefly colon bacilli are less apt to suppurate if lateral drainage is provided and the skin closed loosely if at all. If the abscess contains the gangrenogenic anaerobes, suppuration and necrosis of the gridiron incision occur no matter what is done.

7. Contraction of rectus muscles after median and paramedian incisions and of the lateral muscles after gridiron incisions is not interrupted by operation though it is restricted by pain. Gradually, increasing exercise, begun early, hastens recovery and does not, so far as has been observed, tend to disrupt incisions.

8. The incidence of postoperative hernia can not be determined. The only hernia following a paramedian incision occurred in the case of a physician whose rectus muscle sloughed. It caused no discomfort. A few hernias have followed median suprapubic incisions in consequence of suppuration. Hernias have developed in gridiron incisions only if sloughing has been pronounced.

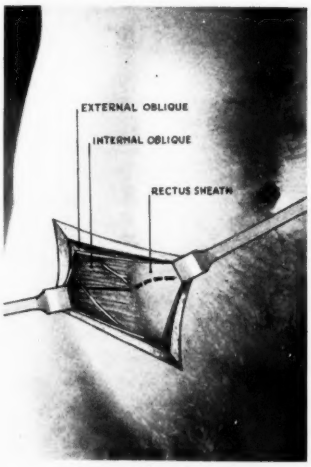

Fig. 16.

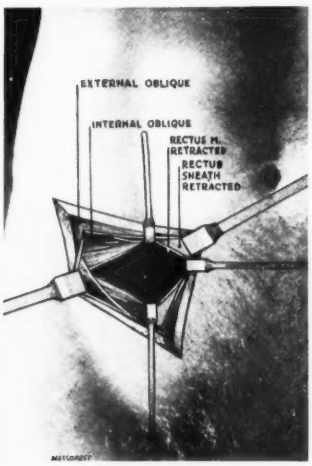

Fig. 17.

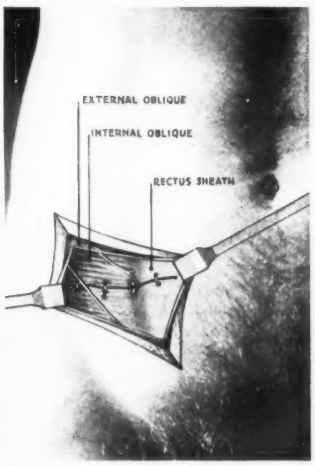

Fig. 18.

Fig. 16. Gridiron incision. Solid line indicates level of separation of fibers of internal oblique in reference to the twelfth thoracic and iliohypogastric nerves. Broken line indicates incision of rectus sheath to obtain the greater exposure suggested by Harrington and Weir.

Fig. 17. Gridiron incision. Exposure obtained by adding the procedure of Harrington and Weir to the incision of McArthur and McBurney. Mobilization and displacement of the twelfth thoracic nerve upward and of the iliohypogastric downward protects these structures from injury.

Fig. 18. Closure of gridiron incision. After the peritoneum had been closed and the margins of the transversalis muscle approximated, the external oblique and rectus fascia were so sutured as to approximate their smooth ventral surfaces and thus reduce the tendency to form adhesions with the contiguous surface of the external oblique.

9. Reactivation of patients, in so far as incisions are concerned, should be as rapid as conditions warrant and as an individual's strength and temperament permit. Well healed gridiron incisions permit patients to leave on the fifth day, some even sooner. Soundly closed paramedian incisions, if tissues are strong, warrant discharge of robust patients in a week; median incisions of this character in 10 days.

CONCLUSIONS

Simple incisions that provide adequate exposure for the majority of intra-abdominal operations, that can be closed soundly, heal rapidly, assure an early recovery of usual activities, and obviate subsequent complications, must be adapted to conform with the structure, function, blood and nerve supply of the parietal tissues.

Median, paramedian, and gridiron incisions can usually be so utilized as to fulfill these requirements, provided the relaxation provided by anæsthesia suffices to prevent forceful muscular contractions during operation, and the closure obtained does not impair healing, is sound enough to prevent early disruption of the wound or the ultimate stretching that leads to diastasis and to hernia.

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OLSHAUSEN'S OPERATION FOR SUSPENSION OF THE UTERUS

A Review of Three Thousand Three Hundred and Fifty-Eight Cases Operated Upon at the Free Hospital for Women, Brookline

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THE Olshausen's operation is the oldest, the simplest to perform, and, in our experience, the most effective of the numerous methods devised for suspending the misplaced uterus. It consists merely in attaching the uterine ends of the round ligaments to the anterior abdominal wall.

HISTORICAL NOTE

The early history of suspension operations has best been told in a footnote on page 306 of the 1905 edition of Hirst's *Text Book of Diseases of Women*. It reads: "Olshausen was the first to perform a modern uterine suspension. Kelly introduced it into America after a visit to Olshausen's clinic. Sims, Keltenbach, Koeberle, Schroeder, Hennig, and Tait had previously attempted to fasten the uterine fundus to the anterior abdominal wall. Boldt and Leopold, in 1890, passed the sutures through the uterine fundus instead of through the uterine cornua and ovarian ligaments as Olshausen originally did."

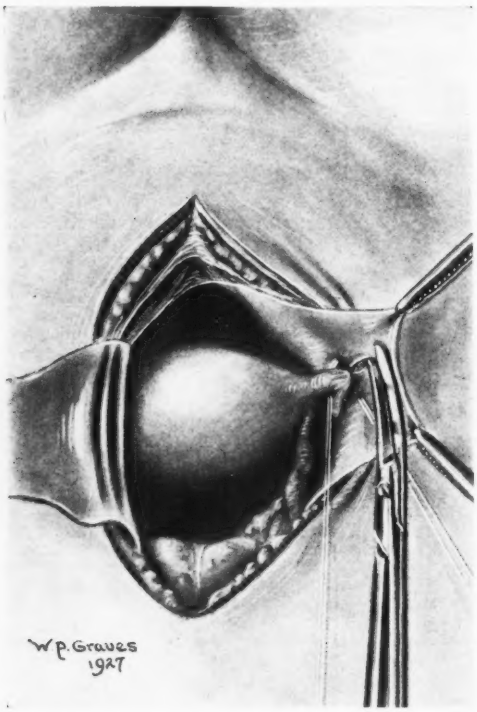

Fig. 1. Olshausen's operation. On the right the double ligature (silk, linen, or catgut) has been placed and tied with the knot inside the abdomen. On the left the needle carrying the ligature is being passed under the round ligament at a short distance from the uterine horn. (From Graves' *Gynecology*.)

The Olshausen's operation was first performed at the Free Hospital for Women in 1890 by Dr. W. H. Baker and was frequently employed by him. The writer (Graves) began using it more than 20 years ago in a series of cases to test the comparative efficiency of the various methods then in vogue for suspending the uterus. Among the other operations included in the test were those devised by Alexander, Wiley, Gilliam, Kelly, Mayo, Simpson, Baldy, and Webster, in all of which the round ligaments were employed. The results of these observations which extended over a number of years were overwhelmingly in favor of the Olshausen's operation, and the writer in 1923 published his conclusions in an article[1] entitled "Olshausen's Operation for Suspension of the Uterus," which he read before the New York Obstetrical Society.

MERITS OF THE OPERATION

The advantages of the Olshausen's operation may be briefly summed up as follows:

1. Its technical simplicity and the consequent rapidity with which it can be performed are unexcelled.

2. It is but an incident in closing the abdominal wound, and can be used with insignificant loss of time in finishing long and complicated operations.

3. It has great supporting power, so that it may be successfully employed in the most extreme cases of procidentia.

4. Since the suspension can be made, on the one hand, at varying levels on the abdominal wall, or at varying distances from the uterine horns, on the other, it is applicable to any length of uterus or degree of prolapse.

[1]Am. J. Obst. & Gynec., 1923, Aug.

5. Symptomatically it results in a maximum of pelvic comfort on account of the high plane in which it holds the uterus, the avoidance of pressure on the bladder, the practically normal mobility of the uterus and appendages, and the excellent drainage that it insures of the genital circulation.

6. When the operation is used as a prophylactic measure against a later retroversion in all conservative pelvic operations, then it is a valuable means of securing permanent symptomatic cures.

7. Since the operation entails a minimum distortion of the pelvic organs and postoperative adhesions, later pelvic operations that may be necessary are not hindered or confused.

8. The operation can be used in childbearing women with comparatively little danger of dystocia, and therefore artificial sterilization is not necessary.

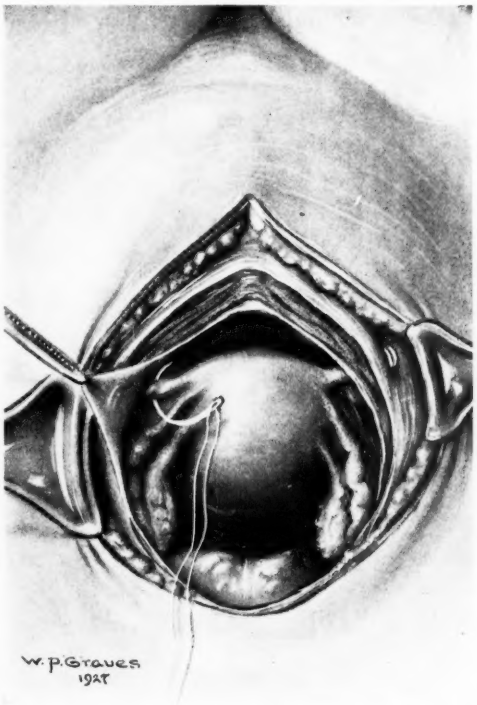

Fig. 2. Olshausen's operation. Special technique when catgut is used. In order to insure a firm adhesion, the bight in the round ligament included in the tie is scarified. On the abdominal side a small slit is made in the peritoneum. (From Graves' *Gynecology.*)

DEFECTS

Long experience with the Olshausen's operation has revealed certain defects that we have endeavored to obviate as far as possible. Until recent years all the operations were performed with heavy silk, which occasionally produced a postoperative sinus. The permanency of the operation was not affected, since the stitch always worked through into the muscular layer, the artificial adhesions remaining intact. In some cases the stitch required an operation for its removal. This unpleasant complication may be largely avoided by the use of linen, and completely so by the use of catgut in the manner to be described (Fig. 2).

The most important danger associated with the Olshausen's operation is obviously that of a later

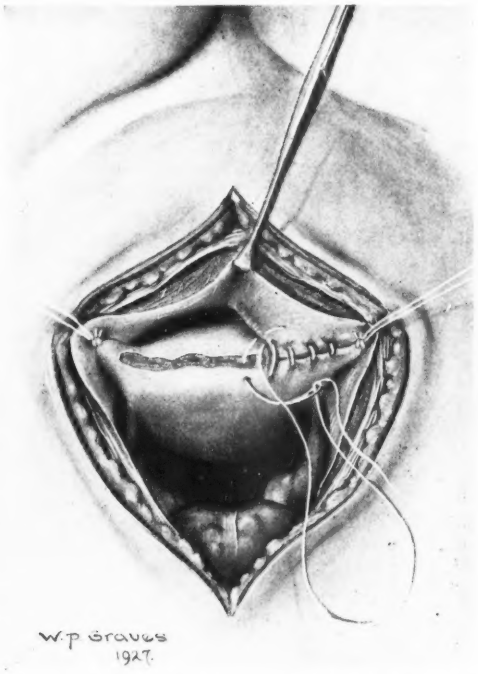

Fig. 3. Olshausen's operation. Modification often used in cases of procidentia beyond the childbearing period when the peritoneum is atrophied. The suspension is first performed in the usual way. For the purpose of gaining additional supporting power, the fundus of the uterus is either scarified or, as in the drawing, denuded by the removal with scissors of a narrow strip of peritoneum. The fundus is then attached with a running catgut stitch to the peritoneum of the anterior abdominal wall. The modification is never used if there is a possibility of later pregnancy. (From Graves' *Gynecology.*)

intestinal obstruction. Every effort has been made to determine the frequency of this event. Six cases in all were discovered, 3 of which were saved by timely operations. The obstruction results from adhesion and anchoring of a loop of small intestine to the peritoneum near the site of the stitch. Any abdominal operation may be followed by a late obstruction in a similar manner. In our hysterectomy series at the Free Hospital, for example, the incidence of late obstruction equals that following uterine suspension. Nor are the so called internal Alexander operations (Mayo, Simpson, etc.), devised to prevent this complication, entirely immune, as has been shown by one of our own cases following a Mayo's suspension.

The possibility of intestinal obstruction should, however, always be borne in mind and should be avoided as far as possible in the manner to be suggested in the section which follows entitled "Contra-indications."

In a very small number of cases a hernia formed at the site of one of the suspending ligatures. This undoubtedly is the result of tying the ligature so tightly that it produces a weak point in the abdominal wall. Other hernias are included in the accompanying statistics. They were due not to the special method of suspension, but represent an unavoidable possibility in any abdominal wound where the tissues have been weakened by child-bearing. Postoperative hernias following such operations may be lessened by performing a routine repair of the separated abdominal recti muscles.

INDICATIONS

The Olshausen's operation is indicated in the following types of cases:

1. Simple retroversion, where the displacement of the uterus can be definitely proved to be the cause of symptoms such as lumbar backache, pelvic pressure, fatigue, dysmenorrhœa, constipation, sterility, miscarriage, and pains in the pampiniform plexus.

2. Intractable cases of acute anteflexion and retrocession, with dysmenorrhœa and sterility.

3. Prolapse of every degree, even to complete procidentia.

4. As a prophylactic measure against retroversion and postoperative adhesions in finishing all conservative pelvic operations with the exceptions noted in the following section.

CONTRA-INDICATIONS

The Olshausen's operation is contra-indicated whenever the peritoneum near the fundus of the uterus is sufficiently damaged to incur the danger of adhesion and anchoring of the intestine, or of adhesion and fixation of the uterus to the abdominal wall. Examples are myomectomy wounds that approach or cross the uterine fundus, extensive salpingectomy wounds, or destructive denudations about the fundus from the release of peritoneal adhesions. Here it is safer to substitute the Coffey principle of folding over the broad ligament above and in front of the uterus. This method of suspension is, in our experience, much less effective, both symptomatically and anatomically, than that of Olshausen, but in these situations noted it is better to sacrifice efficiency to safety. When the dangerous area is one-sided, an excellent maneuver is to use the Coffey method on the affected side and the Olshausen's on the side which is not affected.

TECHNIQUE

The round ligament on each side is grasped by the tip of a long uterine clamp about half an inch from the uterine horn. A double ligature of No. 2 chromic catgut (silk or linen) is passed beneath the ligament at the point included in the clamp. The suture is then passed through the peritoneum, muscle and fascia, and back again, the ends of the suture being tied inside the abdomen. If catgut is used the contiguous surfaces of the peritoneum that are to be included in the tie are scarified before the knot is tied. The accompanying drawings depict the simple details of the operation.

STATISTICS

The following statistics were collected and tabulated by Dr. George Van S. Smith, with the assistance of Dr. M. K. Bartlett, Dr. G. A. Marks, Dr. J. F. Puddicombe, and Miss V. Sheehan.

The operations comprise only those performed at the Free Hospital for Women by members of the staff between 1890 and 1928. For the sake of securing uniformity in records and follow-ups, no private operations by any of the staff have been included.

In order to supplement the data gleaned from the hospital records, 3,736 letters were sent to patients and relatives, and from this correspondence much valuable information was added relating especially to later symptomatology and child-bearing.

Special effort was made to determine any late results of a fatal nature that might be referable to the operation, such as deaths from intestinal obstruction or hindrance to childbearing. To this end a laborious search was made of the Massachusetts mortality records filed at the State House in Boston.

Operations in which Olshausen's Suspension Was Performed

SIMPLE RETROVERSION—678 CASES

	Cases	Per cent
Untraceable	128	18.8
Traceable more than 2 years after operation	326	48.0
Examined more than 1 month after operation	416	61.3
Examined 2 or more years after operation	85	12.5
Operative mortality	1	0.14
Retroperitoneal abscess from papilloma of bladder removed at time of operation.		
Gross results from all follow-ups—		
Symptomatic—		
Cured	365	67.5
Relieved	132	24.4
Failure	43	8.1
Anatomical position of uterus (examined)—		
In position	317	90.5
Partial recurrence	19	5.4
Recurrence	14	4.0
Results based on follow-ups of more than two years—		
Symptomatic—		
Cured	207	63.4
Relieved	92	28.2
Failure	27	8.2
Anatomical position of uterus (examined)—		
In position	64	75.2
Partial recurrence	9	10.5
Recurrence	12	14.1

Pregnancy after operation—

A. After anterior colporrhaphy or perineorrhaphy or both and suspension—

	Cases
Total patients	34
Pregnancies in 34 cases	69
Pregnant at time of follow-up, outcome unknown	4
Results in remaining cases—	
Normal deliveries	39
Abortions	12
Miscarriages	2
Breech delivery	1
Cæsarean section	4
Instrumental deliveries	9
Two normal deliveries	7
Two instrumental deliveries	1
Four normal deliveries	1
Five normal deliveries	1
Four cæsarean deliveries	1

Examined after childbirth—

	Cases	Per cent
Uterus in position	8	61.5
Partial recurrence	2	15.3
Recurrence	3	2.3

B. No plastic beyond dilatation and curettage, trachelorrhaphy, amputation or cauterization of cervix—

	Cases
Total cases	109
Pregnancies in 109 cases	192
Pregnant at time of follow-up, outcome unknown	10
Tubal pregnancies (1 placenta prævia)	2
Results in remaining cases—	
Normal deliveries	102
Abortions	34
Miscarriages	6
Premature deliveries	4
Breech deliveries	3
Cæsarean deliveries	7
Instrumental deliveries	23
Two normal deliveries	8
Three normal deliveries	7
Four normal deliveries	5
Seven normal deliveries	1
Two instrumental deliveries	2
Two cæsarean sections	2

Examined after childbirth—

	Cases	Per cent
Uterus in position	9	52.9
Partial recurrence	4	23.5
Recurrence	4	23.5

ANTEFLEXION AND RETROCESSION—357 CASES

	Cases	Per cent
Untraceable	70	19.6
Traceable more than 2 years after operation	171	47.9
Examined more than 1 month after operation	202	56.5
Examined 2 or more years after operation	40	11.2
Operative mortality	—	—
Gross results from all follow-ups—		
Symptomatic—		
Cured	138	50.9
Relieved	109	40.2
Failure	34	12.5
Anatomical position of uterus (examined)—		
In position	182	90.9
Partial recurrence	12	5.9
Recurrence	8	3.4
Results based on follow-ups of more than 2 years—		
Symptomatic—		
Cured	76	44.4
Relieved	76	44.4
Failure	19	11.1
Anatomical position of uterus (examined)—		
In position	30	75.0
Partial recurrence	6	15.0
Recurrence	4	10.0

Pregnancy after operation—

		Cases
Total traceable cases		287
Pregnancy occurred in	67	23.3
Total pregnancies in 67 cases		138
Pregnant at time of follow-up		7
Tubal pregnancy		1
Results in remaining cases:		
Normal deliveries		61
Abortions		21
Miscarriages		6
Premature delivery		1

	Cases
Breech delivery	3
Cæsarean section	1
Instrumental deliveries	37
Two normal deliveries	7
Three normal deliveries	6
Four normal deliveries	2
Five normal deliveries	1
Two instrumental deliveries	5
Three instrumental deliveries	1
Four instrumental deliveries	1

Examined after childbirth—

	Cases	Per cent
Uterus in position	7	53.8
Partial recurrence	5	38.4
Recurrence	1	7.6

PROLAPSE—1,422 CASES

	Cases	Per cent
Untraceable	215	15.1
Traceable more than 2 years after operation	811	57.0
Examined more than 1 month after operation	822	57.8
Examined 2 or more years after operation	241	16.9
Operative mortality—	8	0.56
1. 48 years of age, pulmonary embolism, 19 days after operation.		
2. 54 years of age, pulmonary embolism, 10 days after operation.		
3. 48 years of age, pulmonary embolism, 1 day after operation.		
4. 42 years of age, pulmonary embolism, 1 day after operation.		
5. 38 years of age, intestinal obstructions 4 days after operation.		
6. 56 years of age, pneumonia 4 days after operation.		
7. 59 years of age, under anæsthesia.		
8. 36 years of age, cerebral embolism, 6 days after operation.		
Gross results from all follow-ups—		
Symptomatic—		
Cured	853	72.0
Relieved	281	23.7
Failure	50	4.2
Anatomical, general results—		
In position	770	94.8
Partial recurrence	30	3.6
Recurrence	22	2.6
Results based on follow-ups of more than 2 years—		
Symptomatic—		
Cured	582	71.7
Relieved	196	24.1
Failure	33	4.0
Anatomical position of organs (examined)—		
In position	209	86.7
Partial recurrence	16	6.6
Recurrence	16	6.6

Pregnancy after operation—	Cases
Total patients	199
Pregnancies in 199 cases	323
Pregnant at time of follow-up, outcome unknown	19
Results in remaining pregnancies—	
Normal deliveries	152
Abortions	57
Miscarriages	15
Premature deliveries	6
Breech delivery	1
Instrumental deliveries	50
Cæsarean deliveries	23
Two instrumental deliveries	8
Four instrumental deliveries	1
Two cæsarean sections	3
Two normal deliveries	19
Three normal deliveries	10
Four normal deliveries	4
Five normal deliveries	1

Examined after childbirth—

	Cases	Per cent
Uterus in position	48	78.6
Partial recurrence	2	3.2
Recurrence	11	18.0

PROCIDENTIAL—294 CASES

	Cases	Per cent
Untraceable	30	10.2
Traceable more than 2 years after operation	162	55.1
Examined more than 1 month after operation	173	58.8
Examined 2 or more years after operation	65	22.1
Operative mortality	3	1.02
1. 70 years old, pneumonia 4 days after operation.		
2. 65 years old, pulmonary embolism, 13 days after operation.		
3. 60 years old, surgical shock, 3 days after operation.		
Gross results from all follow-ups—		
Symptomatic—		
Cured	183	76.5
Relieved	47	19.6
Failure	9	3.7
Anatomical position of organs (examined)—		
In position	126	72.4
Partial recurrence	40	22.9
Recurrence	8	4.5
Results based on follow-ups of more than 2 years—		
Symptomatic—		
Cured	118	72.8
Relieved	36	22.2
Failure	8	4.9
Anatomical position of organs (examined)—		
In position	40	60.6
Partial recurrence	19	28.7
Recurrence	7	10.6

Pregnancy after operation—	Cases	
Traceable cases	264	
Pregnancy occurred in	18	6.8
Total pregnancies in 18 cases	36	
Pregnant at time of follow-up	2	
Results in remaining pregnancies—		
Normal deliveries	9	
Abortions	9	
Miscarriages	5	
Premature deliveries	3	
Cæsarean deliveries	6	
Instrumental deliveries	2	

Examined after childbirth—	Cases	Per cent
Uterus in position	8	72.7
Partial recurrence	1	9.0
Recurrence	2	18.1

PELVIC INFLAMMATION (CONSERVATIVE OPERATIONS)—415 CASES

	Cases	Per cent
Untraceable	94	22.5
Traceable more than 2 years after operation	191	46.0
Examined more than 1 month after operation	259	62.4
Examined 2 or more years after operation	70	16.8
Operative mortality (peritonitis)	1	0.24
Gross results from all follow-ups—		
Symptomatic—		
Cured	204	63.9
Relieved	102	31.9
Failure	13	4.0
Anatomical position of uterus (examined)—		
In position	212	81.8
Partial recurrence	38	14.6
Recurrence	9	3.4
Results based on follow-ups of more than 2 years—		
Symptomatic—		
Cured	124	64.2
Relieved	61	31.6
Failure	6	4.2
Anatomical position of uterus (examined)—		
In position	47	67.1
Partial recurrence	18	25.7
Recurrence	5	7.2

Pregnancy after operation—		Cases
Traceable cases		321
Pregnancy occurred in	45	14.0
Total pregnancies in 45 cases		69
Pregnant at time of follow-up		4
Tubal pregnancy		3
Results in remaining pregnancies—		
Normal deliveries		27
Abortions		20
Miscarriages		4
Cæsarean delivery		1
Breech delivery		1
Instrumental deliveries		9
Two normal deliveries		3
Three normal deliveries		1
Two instrumental deliveries		2
Examined after childbirth—		
Uterus in position	8	72.7
Partial recurrence	3	27.2
Recurrence	—	—

TUBERCULOSIS SALPINGITIS (CONSERVATIVE OPERATIONS)—22 CASES

	Cases	Per cent
Untraceable	6	27.2
Traceable more than 2 years after operation	8	36.3
Examined more than 1 month after operation	13	59.0
Examined 2 or more years after operation	2	9.0
Operative mortality	—	—
Gross results from all follow-ups—		
Symptomatic—		
Cured	12	75.0
Relieved	3	18.7
Failure	1	6.2
Anatomical position of uterus (examined)—		
In position	11	84.6
Partial recurrence	2	15.3
Recurrence	—	—
Results based on follow-ups of more than 2 years—		
Symptomatic—		
Cured	6	75.0
Relieved	2	25.0
Failure	—	—
Anatomical position of uterus (examined)—		
In position	1	50.0
Partial recurrence	1	50.0
Recurrence	—	—
Pregnancy after operation—		
Definitely known	—	—

One patient 11 months after operation wrote she was 9 months pregnant.

MULTIPLE FIBROIDS (MYOMECTOMY)—33 CASES

	Cases	Per cent
Untraceable	5	15.1
Traceable more than 2 years after operation	14	42.4
Examined more than 1 month after operation	23	69.6
Examined 2 years or more after operation	6	18.1
Operative mortality	—	—
Gross results from all follow-ups—		
Symptomatic—		
Cured	19	73.0
Relieved	4	15.3
Failure	3	11.5
Anatomical position of uterus (examined)—		
In position	17	80.9
Partial recurrence	2	9.5
Recurrence	2	9.5
Results based on follow-ups of more than 2 years—		
Symptomatic—		
Cured	9	64.2
Relieved	3	21.4
Failure	2	14.2
Anatomical position of uterus (examined)—		
In position	3	50.0
Partial recurrence	2	33.3
Recurrence	1	16.6

Pregnancy after operation—	Cases
Total patients	4
Pregnancies in 4 cases	8
Normal deliveries	5
Abortion	1
Pregnant at time of follow-up	2
Cured	4

OVARIAN TUMORS—86 CASES

	Cases	Per cent
Untraceable	18	20.9
Traceable more than 2 years after operation	51	59.3
Examined more than 1 month after operation	43	50.0
Examined 2 or more years after operation	14	16.2
Operative mortality	2	2.3
1. 30 years of age, pneumonia 3 days after operation.		
2. 60 years of age, surgical shock, 3 days after operation.		
Gross results of follow-up—		
Symptomatic—		
Cured	54	77.1
Relieved	15	21.4
Failure	1	1.4
Anatomical position of uterus (examined)—		
In position	37	86.0
Partial recurrence	5	11.6
Recurrence	1	2.3
Results based on follow-ups of more than 2 years—		
Symptomatic—		
Cured	36	70.5
Relieved	14	27.4
Failure	1	1.9
Anatomical position of uterus (examined)—		
In position	8	57.1
Partial recurrence	5	35.7
Recurrence	1	7.1

Pregnancy after operation—	Cases	
Traceable cases	68	
Pregnancy occurred in	9	13.2
Total pregnancies in 9 cases	15	
Pregnant at time of follow-up	1	
Results in remaining pregnancies—		
Normal deliveries	8	
Abortions	4	
Instrumental deliveries	2	
Examined after childbirth—		
Uterus in position	2	100.00
Partial recurrence	—	—
Recurrence	—	—

ENDOMETRIOSIS—26 CASES

	Cases	Per cent
Untraceable	4	15.3
Traceable more than 2 years after operation	13	50.0
Examined more than 1 month after operation	18	69.2
Examined 2 or more years after operation	7	26.9
Operative mortality	—	—
Gross results from all follow-ups—		
Symptomatic—		
Cured	13	59.0
Relieved	6	27.2
Failure	3	13.6
Anatomical position of uterus (examined)—		
In position	14	77.7
Partial recurrence	3	16.6
Failure	1	5.5
Results based on follow-ups of more than 2 years—		
Symptomatic—		
Cured	9	69.2
Relieved	1	7.6
Failure	3	23.0
Anatomical position of uterus (examined)—		
In position	6	85.7
Partial recurrence	—	—
Recurrence	1	14.3

Pregnancy after operation—	Cases
Normal pregnancy and delivery (cured)	1

TUBAL PREGNANCY—25 CASES

	Cases	Per cent
Untraceable	9	36.0
Traceable more than 2 years after operation	11	44.0
Examined more than 1 year after operation	11	44.0
Examined 2 years or more after operation	3	12.0
Operative mortality	—	—
Gross results from all follow-ups—		
Symptomatic—		
Cured	13	81.2
Relieved	2	12.5
Failure	1	6.2
Anatomical position of uterus (examined)—		
In position	10	90.9
Recurrence	1	9.1
Failure	—	—
Results based on follow-ups of more than 2 years—		
Symptomatic—		
Cured	10	90.9
Relieved	—	—
Failure	1	9.1
Anatomical position of uterus—		
In position	3	100.0
Partial recurrence	—	—
Recurrence	—	—

Pregnancy after operation—	Cases	
Pregnant	3	
Pregnancies in 3	5	
Second tubal pregnancy	2	
Abortion, two normal pregnancies and deliveries	1	
Cured	3	100.00

SUMMARY OF ALL STATISTICS

	Cases	Per cent
Total number of cases	3358	
Untraceable	579	17.2
Traceable more than 2 years after operation	1758	52.3
Examined more than 1 month after operation	1980	58.9
Examined 2 or more years after operation	533	15.8
Operative mortality	15	0.446
Peritonitis	1	
Pneumonia	3	
Pulmonary embolism	5	

	Cases	
Surgical shock	2	
Pelvic abscess	1	
Cerebral embolism	1	
Under anæsthesia	1	
Intestinal obstruction	1	
Gross results from all follow-ups in 2764 traceable cases—		
Symptomatic—	Cases	Per Cent
Cured	1854	68.5
Relieved	701	25.9
Failure	158	5.8
Anatomical position of uterus (examined)—		
In position	1696	83.4
Partial recurrence	152	7.9
Recurrence	65	3.3
Results based on follow-ups of more than 2 years—		
Symptomatic—		
Cured	1177	66.8
Relieved	481	27.3
Failure	100	5.6
Anatomical position of uterus (examined)—		
In position	411	76.9
Partial recurrence	76	14.2
Recurrence	47	8.8
Pregnancy after operation—		Cases
Traceable cases		2764
Pregnancies occurred in	489	17.6
Pregnancies in 489 patients		856
Pregnant at time of follow-up, outcome unknown		49
Tubal pregnancies		8
Placenta prævia		1
Deaths associated with later pregnancy		8
Intestinal obstruction 2 months after delivery.		
Postpartum influenza—2 cases.		
Following dilatation and curettage for retained products.		
Placenta prævia with hæmorrhage.		
Following cæsarean section.		
During labor—cause unknown.		
Puerperal septicæmia.		
Results in remaining pregnancies—		
Normal deliveries		406
Abortions		159
Miscarriages		38
Premature deliveries		14
Breech deliveries		9
Cæsarean deliveries		42
Instrumental deliveries		132
In all 575 living, normal children were born to the group of 489 patients who had later pregnancies.		
Examined after childbirth—		
Uterus in position	95	71.4
Partial recurrence	17	12.7
Recurrence	21	15.7

These 489 patients comprise 21.2 per cent of all the traceable patients in the series that were under the age of 45 at the time of operation and consequently were in the childbearing age.

LATER DEATHS

As has been stated, the mortality records at the Massachusetts State House were searched in order to obtain information not in the Hospital records regarding later childbearing and intestinal obstruction. Since the deaths from causes other than these two have no special bearing on the subject of the Olshausen's operation, they will not be given in detail in this report. The mortality figures relating to childbirth are given above in the summary of statistics. The incidence of intestinal obstruction follows.

INTESTINAL OBSTRUCTION

There are in all 6 cases known to have had intestinal obstruction. Of these, 2 died without operation. Of the 4 that were operated upon, 3 survived and are living today. Whether or not the obstruction was in every case due to the Olshausen's operation it is impossible to say.

The data of the 6 cases are as follows:

1. Pelvic Inflammation. 22 years old. Second operation at Free Hospital for Women. Survived.

2. Anteflexion and Retrocession. Obstruction followed childbirth 1 year and 6 months after operation. Patient died. Reported above as childbirth death.

3. Retroversion. Operation for obstruction done elsewhere. Patient is well and writes: "No fault of first operation."

4. Prolapse. 38 years old. Died 4 days after prolapse operation at Free Hospital. No second operation. Reported above as operative death.

5. Prolapse. 46 years old. Operated on for obstruction 46 days after prolapse operation and died.

6. Prolapse. Later "operation for adhesions which caused stoppage." Recovery. Well 6 years and 1 month after prolapse operation.

POSTOPERATIVE HERNIA

There were 41 cases of postoperative hernia, an incidence of 1.47 per cent in the followed cases. Ten hernias developed in less than 1 year after operation; 21 appeared in less than 2 years. The rest were late developments. Most of the hernias occurred in multiparous women with weak abdominal walls.

SILK STITCH SINUS

A silk stitch sinus occurred in 45 cases, an incidence of 1.34 per cent. Nineteen occurred in the pelvic inflammation group, 9 in the retroversion, and 14 in the prolapse groups. We have abandoned the use of silk in favor of catgut.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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MAY, 1931

PERSPECTIVE

AN extraordinary development of laboratory methods has come to the aid of clinical diagnosis, but the enormous amount of detailed information which has accompanied this growth has resulted in some confusion in medical practice.

The proper practice of medicine must include wide knowledge of clinical diagnostic methods and some skill in the manipulation of such instruments of precision as have won their way to standing in the medical profession. Although this new development makes essential an understanding of laboratory examinations and their application to individual patients, knowledge of the details of the methods themselves is not so essential. It is important that the practitioner should relate the history, symptoms, and laboratory investigations to the clinical condition of the patient, but machine methods should not be allowed to take the place of clinical investigation. It might be said that a good clinical investigator uses the laboratory as an aid but is not controlled by it.

In teaching young men, we should insist that in clinical examinations they first record a résumé of the patient's history, including symptoms. Then a general physical examination should be made with the aid of common instruments of investigation; that is, with the stethoscope, speculums, and the microscope, to such an extent as the practitioner should be able to use them. Next, the tentative clinical diagnosis should be written down before the patient is sent on a round of laboratory tests. Sometimes it is difficult to prevent the well trained young physician from sending the patient for laboratory investigation after a cursory clinical examination. A man on a fellowship, a well trained young physician and now one of the best, after making a fairly complete clinical study, gave the patient a card ordering roentgenographic examination of his teeth. The patient at once reached into his mouth, pulled out two complete plates of teeth, and asked "When can I have them back?"

To illustrate just what perspective means, if a patient comes in with a definite history of gall-stone disease, it is not so important to make roentgenographic examination as it is to make a careful general physical examination to learn whether there is good reason why an operation should not be performed. Frequently patients give a clear clinical history of gall-stone disease, but a negative roentgenographic report is received, and the physician on that account advises against an operation which he would have advised if the cholecystographic report had given positive indication of disease. Papillomata of the gall bladder, cholesterosis, and other conditions unaccom-

panied by stones may not give definite roentgenological evidence of their presence unless the picture is taken during an attack in which inflammatory swelling has produced obstruction of the cystic duct. Yet these conditions are just as essentially surgical as they are in those cases in which the roentgenogram gives evidence of stones or of a non-functioning gall bladder.

Too great dependence on roentgenological evidence may be misleading in the diagnosis of duodenal or gastric ulcer. The extraordinary efficiency of the roentgenologist in the diagnosis of duodenal or gastric ulcers sometimes leads to overemphasis on the importance of the roentgenological examination. Probably 5 per cent of ulcers of the stomach and duodenum will not give evidence of their presence on roentgenological examination, sometimes not even in a series of exposures. However, if the clinical history is complete and if clinical methods of examination have given evidence of the presence of ulcer, a negative result of roentgenological examination should not lead to the belief that ulcer is not present.

In acute conditions, such as suspected obstruction of the bowels, the introduction of opaque mixtures for the purpose of radiographic examination may increase the blocking at the obstructed portion. In such cases the use of spinal anæsthesia will often so relax the intestines that, if the obstruction is not mechanical, flatus usually will pass within 20 minutes. If flatus does not pass, the diagnosis of obstruction is probable, the patient is already under an anæsthetic, and the necessary operation can be carried out at once. In intestinal obstruction general anæsthesia is dangerous; local abdominal wall block anæsthesia is the choice. Even if the stomach is carefully emptied immediately before operation, reverse peristalsis may set in, carrying the liquids up into the pharynx, where they may be inhaled into the lungs; the result may be septic bronchitis, from which the patient may die in the course of a week or 10 days, or the patient may even drown on the operating table.

It sometimes happens after an abdominal operation that a patient may begin to give evidence of possible intestinal obstruction. This is an anxious time for the surgeon, because he does not know that obstruction actually exists. In such a case, spinal anæsthesia may give the answer. If symptoms are not promptly relieved, the abdominal incision can be reopened, and manual examination can be made. If this is done within 72 hours after the original operation, and adhesions or kinking, the result of the operation, are causing the obstruction, they can be readily separated. Under such circumstances, when I have found and relieved this form of early acute obstruction, I have brought the intestine up to the abdominal incision at a point just proximal to the obstructed part and have fastened a small portion of it to the peritoneal surface by a few threads left long, so that ileostomy could be readily done later if the obstruction were not relieved. However, it has been exceedingly rare that ileostomy has been necessary. If the favorable time of the fourth day is allowed to go by, and obstruction exists, the adhesions usually cannot be separated readily with the fingers without injury, and more serious procedures must take the place of this simple, effectual, and safe procedure. In late obstruction in a toxic patient local anæsthesia is safer than spinal anæsthesia; Counseller points out the rapid lowering of blood pressure which sometimes follows spinal anæsthesia in such cases.

W. J. Mayo.

APPENDICITIS ONCE MORE

THE reason for the high mortality of acute appendicitis is not far to seek: it is a disease the death rate of which increases with each hour that surgical relief is deferred. Yet patients with acute appendicitis are still being treated expectantly, not as a matter of policy, but because the medical attendant—who is not always the much maligned general practitioner—has no fixed conviction about his diagnosis. Now this is not the expectant treatment advocated by Fowler, Ochsner, Murphy, and Deaver, and advocated by them, be it remembered, not as a matter of choice in primary appendicitis, but as a matter of expediency in secondary peritonitis. Whether we approve of the policy of expectant treatment in advanced cases of appendicitis is not germane to this discussion. The point is that even its most ardent champions do not advocate it for early cases. There can be no discussion of the dictum that the first stage of the disease, as Murphy puts it, is the acceptable time for salvation and likewise the time for removing the appendix.

Knowing this, believing this, why do physicians delay? Again the reply is obvious. They delay because in the majority of cases the diagnosis is clouded by the fact that the so called classic syndrome is not present. Appendicitis without abdominal pain—though not at first right-sided pain—is unthinkable. But after pain the symptoms and the physical findings always vary in their incidence and in their combinations. "The only hand that paints a perfect pathological picture," it has been well said, "is the hand of death," and the only safety in appendicitis is diagnosis before that perfect picture is painted. The internist who diagnoses acute appendicitis, the surgeon who operates for it only when the full complement of symptoms is apparent, may achieve enviable reputations for diagnostic acumen, but their fame will be chiefly in the autopsy room, for they will have few living patients to their credit.

This is a disease in which operation is justified on the mere suspicion that it exists. A hair-splitting diagnosis, as Deaver aptly says, rarely gets a surgical patient anywhere except possibly to the grave, and the best authorities are agreed that exploration in suspected surgical conditions is always less harmful than delay, and that a few unnecessary incisions into a live patient are infinitely better than a single autopsy on a dead one.

Of course the medical profession is not altogether to blame. Some day some physician is going to lose his temper and write a paper on the responsibility of the public for its own death rate. The salvation of the individual suffering from acute appendicitis undoubtedly depends above everything else upon the promptness with which he obtains relief—but relief cannot be given to him until he applies for it and until he accepts it. Surgeons cannot force people to consult them, they cannot operate on them against their wills, and the group "opposed to operations" and swallowing with avidity old wives' tales of their horrors is still surprisingly large and is composed of a surprising number of persons one would be inclined to credit with more common sense.

The chief activity of lay persons engaged in the business of self-treatment is the taking of purgatives, and a purgative in acute appendicitis has all the effect of a charge of dynamite. It practically always initiates rupture, gangrene, abscess formation, and peritonitis. It practically always, as Moynihan says, is not only the impressive antecedent of such pathology but also its definite cause.

In a recent study made by the writer[1] of 239 deaths from acute appendicitis, collected from

[1] J. Coll. Surg. Australasia, 1930, July.

the records of Charity Hospital and Touro Infirmary in New Orleans, more than 42 per cent of the patients gave a history of having taken purgatives, and in this group of 103 cases, only 2 patients exhibited disease of the simple acute type. An extraordinary fact in connection with these figures is that many more patients, 17 per cent more, to be exact, had treated themselves in this fashion at the private hospital than had done so at the public hospital, where presumably a lower level of intelligence would prevail. And a second astounding fact is that in 12.6 per cent of these cases the purgative was taken on the advice of the medical attendant. Before such a situation one is rather aghast. For physicians must know, even if lay persons do not, that abdominal pain can be the precursor of many serious surgical diseases, and that it is most often the precursor of acute appendicitis, in which purgation is akin to suicide.

Appendicitis is perhaps the best known of all diseases. It is beyond doubt the best known of all surgical diseases. In its typical syndrome it is so clearcut that the intelligent lay person can diagnose it, in its earliest stages it is so simple that a beginner in surgery can handle it. But in the vast majority of cases it begins with symptoms which do not suggest the popular, or, most unfortunately, the medical conception of it, and in a large proportion of cases it never presents the classic syndrome at all or until the patient is *in extremis*. For this reason it is ignored by the laity and misunderstood by the profession, and treated by both groups by ill-advised and dangerous methods which double the dangers of delay. When it has passed beyond its first stages it offers problems of judgment and technique which tax to the utmost the resources of expert surgeons, and yet, because it is supposed to be a simple disease and because appendectomy is supposed to be a simple operation, the merest neophyte in surgery feels himself competent to handle it.

The remedy is simple. The laity must be educated out of its pernicious habit of self-medication, must be taught that abdominal pain is the most urgent of all indications for refraining from purgation. And the profession might well be taught the same thing, for some of them seem to have forgotten it. Physicians might well be taught also that the textbook syndrome of appendicitis is too often the syndrome of the consequent peritonitis, and that when it appears, the patient's life hangs in the balance and surgery should be the business only of the trained and experienced and wise surgeon. More than one authority of eminence has made the point that much of the present mortality in appendicitis, as in other surgical diseases, is due to the occasional operator and to the license which permits him to wield the knife when his chief qualification is simply his desire to do so.

Laity and profession alike must be taught that the major factor in the mortality of appendicitis is the factor of delay, and that only by the reduction of the interval between the onset of symptoms and the institution of surgical relief—the length of the interval being the responsibility of the medical attendant as well as of the patient—can it be brought within reasonable limits. Surgical accidents are bound to occur, certain cases are inherently fatal, and so some patients will inevitably die, no matter how early operation is done. But the patient who is operated on within 12 or even within 24 hours will in the overwhelming majority of cases go on to recovery, and to uncomplicated recovery at that, for the outcome of any given case of appendicitis rests not upon chance but upon the promptness with which the patient seeks relief and the promptness with which the surgeon institutes it.

C. Jeff Miller.

CORRESPONDENCE

DIAGNOSIS OF CONTRACTED PELVIS BY IMPRESSION METHOD

To the Editor: In SURGERY, GYNECOLOGY AND OBSTETRICS, December, 1930, p. 852, Dr. David S. Hillis gives his views on the diagnosis of contracted pelvis by impression method. For several years I have been practicing a method which is a modification of Mueller's method, and is quite painless.

With the patient lying flat on her back on a firm couch and the examiner standing at her side, the fetal head is palpated and the tips of the index and middle fingers of one hand are applied firmly to the sinciput and the tips of the corresponding fingers of the other hand firmly to the occiput. The patient is then *assisted* by the nurse to sit up when the head can be felt to enter the brim (if normal conditions appertain), sliding past the examining fingers. When the patient is assisted to lie down again the *status quo ante* is resumed. It is very interesting to note in cases of "deflexion" of the head how the head in "borderline" cases will not enter the brim whereas when proper flexion has been restored by maneuver the head readily enters. J. LEON JONA, D.Sc.
Melbourne, Australia.

AN HISTOLOGICAL STUDY OF THE PERIVAGINAL FASCIA IN A NULLIPARA

To the Editor: In your journal of January, 1931, there appeared an interesting and scientific article by Dr. Byron H. Goff, entitled: "An Histological Study of the Perivaginal Fascia in a Nullipara"

While I am in accord with its substance, I find myself, greatly to my surprise, depicted as being out of accord and it is to correct this impression that I am sending you this communication.

The introductory paragraph of the article mentioned contains the following sentences: "Some contend that there is a layer of fascia between the wall of the vagina and the walls of the urethra, bladder, and rectum. They believe that obstetric injury to this fascia is the fundamental cause of cystocele, rectocele, and urethrocele. Furthermore, when operating for these conditions, they demonstrate, by dissecting a layer of pallid tissue several millimeters thick which lies just beneath the vaginal mucosa, and term it fascia."

When the bibliography of Dr. Goff's article is scanned, the inevitable conclusion is that I believe and teach that the structure of the vaginal wall, utilized by me for the purpose of correcting prolapse of the anterior vaginal wall, is fascia.

My article to which Dr. Goff refers in his bibliography was written in 1918, during the very early period of the study of lapping of vaginal tissue for the correction of cystocele and prolapse. Two years later, however, I began to question the accuracy of the view that the tissue used was fascia. I then had microscopic studies made of the vaginal wall tissue removed during operations. My conclusions, as the result of these studies, were published in 1929, in the April issue of your journal. The title of this article was: "Fascia Lapping as Applied to the Tissues of the Vaginal Wall—A Misnomer." In this article I distinctly stated that the vaginal tissue utilized in the lapping technique, for the cure of cystocele or prolapse, is not fascia but muscle and that, as no fascial layer can be demonstrated in this tissue, the term "fascia lapping" is a misnomer.

However, if Dr. Goff's article aids (and I think it will) in the crusade of making the gynecologist appreciate and teach the fact that the tissue of the vaginal wall, utilized in the lapping technique for the cure of cystocele, is not fascia but muscle, no one will be more pleased than I am.

NEW YORK, NEW YORK. DOUGAL BISSELL.
January 29, 1931

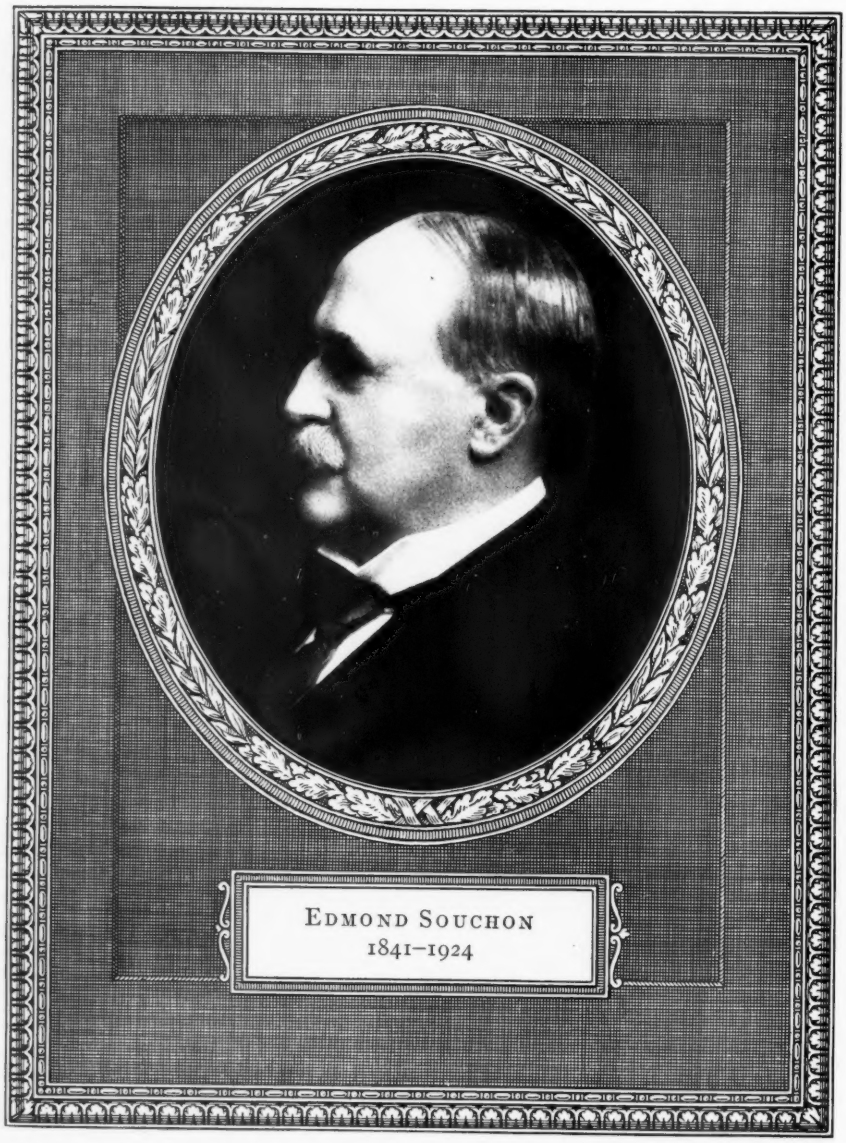
AMERICAN PHYSICIANS ARE WELCOME IN THE HUNGARIAN CLINICS

To the Editor: A few months ago there appeared in the American press several articles stating that American physicians were no longer welcome in the Hungarian clinics and that the privilege of allowing Americans to enroll as postgraduate students had been withdrawn.

Just at this time an editorial of mine on "Hungarian Surgery" appeared in SURGERY, GYNECOLOGY AND OBSTETRICS and since then I have received so many letters with regard to the matter, I should like to reiterate here that a genuine and sincere welcome awaits the American surgeons in the clinics of Budapest, and to deny the veracity of the remarks that so garbled the true state of affairs. American physicians are most cordially received as visitors and as postgraduate students. As to permitting the performing of operations by students and inexperienced surgeons, the Hungarian surgical profession must protect itself and its people, just as is done by the profession in our own country.

May I not take this occasion again to urge the American doctor visiting the European clinics to continue his travels a few hours east of Vienna to the beautiful old world capital of Hungary—Budapest—a city of rare charm and delightful people—a city having a wealth of clinical material and a galaxy of distinguished surgeons and medical men teaching the undergraduate and postgraduate students.

DONALD GUTHRIE, M.D.
Sayre, Pennsylvania.



EDMOND SOUCHON
1841–1924

MASTER SURGEONS OF AMERICA

EDMOND SOUCHON

ON August 5, 1924, Dr. Edmond Souchon, emeritus professor of anatomy and clinical surgery in the Medical School of the Tulane University of Louisiana, came to the close of a long life of great activity and distinguished service.

Dr. Souchon was a native of Louisiana and his professional life is intimately associated with the medical history of his state as an anatomist, surgeon, sanitarian, medical educator, and contributor to the literature and technical advancement of his profession.

Edmond Souchon was born in Opelousas, Louisiana, on December 1, 1841. His father, Dr. Eugene Souchon, and his mother, Caroline (Pettit) Souchon, were both natives of France. His earliest schooldays began at St. Martinsville, Louisiana, but at the age of 12 years his parents moved to Mobile, Alabama, and thence to New Orleans, where he studied in private schools. Owing to his father's ill health and reverses of fortune he was obliged to continue his education in the public schools under great disadvantage, to the extent of selling newspapers to aid in the support of the family. With his father's improving health the financial distress of the family was relieved, and the boy was sent to France to continue his collegiate preparation for a medical career.

A studious and ambitious pupil, he made rapid progress, and in 1860 matriculated in the École de Médecine of the University of Paris. With the outbreak of the Civil War at home his allowance ceased, and he was put on his own resources to meet his living and college expenses for the following 4 years. Urged by the spur of necessity he proved his mettle by passing a grilling *concours* for the interneship of the Paris hospitals, standing fourth in a list of three hundred and fifty competitors, with the distinction of Laureat. He was admitted as a resident at the Charité, in the service of Velpeau, the most conspicuous surgeon in the Paris of that day.

It was there that Dr. Souchon first met Dr. J. Marion Sims, who was to be one of the two great friends of his life. Dr. Sims was then an obscure American physician who had had the temerity to cross the Atlantic to teach the great intellectuals and masters of surgery in Paris how to cure vesicovaginal fistula. Dr. Souchon acted as his interpreter and assistant, and becoming aware of his young friend's financial distress, Dr. Sims tided him over the most critical period of his

student career. Dr. Souchon's gratitude and admiration for Marion Sims is revealed in his "Reminiscences of J. Marion Sims in Paris" and "The Places Made Famous by Marion Sims in Montgomery, Alabama."

His father's death hastened his return to the United States, and he came back to New Orleans and received the degree of medicine from the Medical Department of the University of Louisiana in 1867.

A letter of introduction from Dr. Sims to Dr. T. G. Richardson, then professor of anatomy and clinical surgery, marked a second epoch in Dr. Souchon's life. He assisted Dr. Richardson in private practice, and became his prosector and chief of clinic at the Charity Hospital. How deeply and tenderly he cherished Dr. Richardson's favor and friendship is shown in his "Reminiscences of Dr. T. G. Richardson."

In 1872, Dr. Souchon became demonstrator of anatomy in the Medical Department of the University of Louisiana, and served for 4 years. In 1885, he was elected professor of anatomy and clinical surgery and filled this chair for 23 years. While professor of anatomy he laid the foundation for the Museum of Anatomy, now known by his name, which is entirely representative of his anatomical handicraft. It contains over 400 dissections, admirably preserved by original methods of injection and coloration, described in the *Anatomical Record*, Philadelphia.

As a teacher of anatomy his chief aim, like that of all his predecessors and contemporaries, was to teach human anatomy in its practical applications to the needs of the practitioner of medicine. He viewed the subject from the standpoint of what was most useful in the interpretation of function, disease, and injury in the light of the progress accomplished in his day. The importance that he attached to method and system in study is everywhere apparent in his work. These fundamental ideas are especially conspicuous in his "Plea for a Methodically Written Textbook of Anatomy," in his "Guide for Describing an Organ," in papers on "How to Learn and Remember Anatomy," and in his surgical teachings, as exemplified in his papers on the "Methodic Description of a Surgical Disease" and "Method of Reporting a Surgical Case."

In surgery he was essentially an operator of the anatomical era. He naturally excelled in all operations which required a knowledge of anatomy and in this he was soon recognized and quickly acquired an independent and lucrative practice. It was his ability as an anatomist that led to his association with Dr. Andrew Smyth, the eminent surgeon-in-chief of Charity Hospital, in connection with the historic case of Banks, the negro patient, whose innominate artery Dr. Smyth successfully ligated for aneurism for the first time in surgical history. This case stimulated Dr. Souchon to pursue his studies on aneurism, and later on dislocations of the shoulder joint. His many monographs on these subjects will remain conspicuous landmarks in the history of these subjects and are undoubtedly the most enduring literary monuments of his surgical career.

In addition to the exacting demands of a large clientele he found time to give expression to his thoughts and ideas in a large number of publications, which, up to the last years of his life, kept pace with his diversified activities and reflected the working of his busy mind.

In 1898, Dr. Souchon was elected president of the State Board of Health of Louisiana, and held this position for 7 years, leaving a record of efficiency and accomplishment. With this election he entered into an entirely new phase of his medical experience, which gave him ample opportunity to use the executive and administrative talents which he naturally possessed.

He prepared a sanitary code which is now regarded as the most complete and useful guide to the health laws and sanitary regulations of the state. He contributed actively in framing the "Atlanta Regulations," adopted by the Southern States in 1898, thereby greatly alleviating the burdens of quarantine imposed upon the commerce of the South whenever yellow fever broke out in any community.

In addition to his official and professional titles, Dr. Souchon held many other positions of distinction and responsibility. He had been president of the New Orleans Medical and Surgical Association, president of the Orleans Parish Medical Society, vice-president of the American Medical Association, fellow of the American Association of Anatomists, fellow of the American Surgical Association (1895–1924, vice-president 1899); honorary fellow of the American College of Surgeons; corresponding member of the Société Nationale de Chirurgie de Paris (since 1900); chairman of the medical committee of the board of administrators of the Charity Hospital (1879–1882); and member of numerous other organizations.

Much could be said of his personal characteristics, which were those of a man of very positive opinions and convictions, but the two dominant traits that overshadowed all others were his passion for *punctuality* and method. Though seemingly unsentimental at times and with his attention wholly engrossed in the business at hand, he was capable of great outbursts of enthusiasm and expression. His loyalty and devotion to Marion Sims and Richardson, who had befriended him in his struggling youth, will always be quoted by those who knew him as proof of the undying quality of his friendship and affection. His domestic life was ideal. His happiness centered in the family circle, with the companionship of his wife and children as the *summum bonum* of his existence.

RUDOLPH MATAS.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., F.A.C.S., OMAHA

WILLIAM OF SALICET

DURING the thirteenth and fourteenth centuries the surgeons of importance far outnumbered the practitioners of internal medicine. Even the men who had graduated in medicine and made more or less of a name for themselves, in their later and more mature years turned to surgery until the list of great surgeons of that period is a long and pretentious one. The explanation may be offered that the period was that of the last of the crusades and because of war and its wounds the medical mind veered to surgery. This explanation, however, does not seem to satisfy completely, as wounds were comparatively few and could not entirely dominate the scene. Moreover, many men away from home, in a hot country to which they were strangers, must have presented problems of sanitation and preventive medicine which could fully occupy the time of many medical men. Also if war surgery had dominated the picture the surgeons would certainly have written of their cases and results, but it is surprising how few specific references to war surgery and its results are found in the writings of the surgeons of the period. The above explanations failing to answer the question fully; the reason, as all reasons, must be sought for in a state of mind, in other words the practice of surgery was probably intellectually more satisfactory than that of medicine.

A glance at conditions in internal medicine at this time will tend to confirm this idea. The Hippocratic and Galenic doctrines, altered somewhat by the views of the Arabians, held full sway, but whereas these ancients had cast aside the supernatural and magical and come down to realities, these influences had come back with vigor renewed after their long absence and overshadowed all else. This was particularly true in the line of treatment. Astrology was the most important of the forms of godly intervention and control over human life. The medical men wrote long dissertations on the influence of the heavenly bodies upon disease and its treatment. Petrus de Abanus, one of the most famous internists of this time, says that the critical day in an illness was influenced greatly by the phase of the moon. That bleeding is best performed in the second quarter of the moon because its light was then waxing to its greatest and hence the power of the moon was greatest. That to cure renal colic the best treatment was to draw a picture of a lion on a gold platter and hang it up when the sun passed across the meridian in company with Regulus. One can easily imagine that with this type of medical practice the man of ordinary intelligence might turn to surgery.

William of Salicet, also known as Master Placentinus from his birth place, Piacenza, was one of these. He was born about 1210 and lived and taught in Bologna the greater part of his life. In his later years he became city and hospital physician in Verona and finished his surgery in that town in 1275. He says he started it in Bologna four years before, at the request of Rufino, the Prior of Saint Ambrogio in Vicenza. The work was first printed in 1476 at Piacenza and went through many reprints both separately and in collections. The reproduction here given is taken from a collection called *Ars Chirurgica* headed by the surgery of Guy de Chauliac and printed at Venice by the Iunta press in 1546. The illustration shows some of the cautery irons used by William, which evidently follow the designs of Albucasis.

Placentinus was primarily an operating surgeon and followed the school of Roger and Roland. Unlike the surgeons of a little later period he did the operating himself and did not leave it to laics who followed his directions. In this he was quite advanced for he was a cleric and was one of the first of the Italian surgeons to break away from the religious dictum that the Church abhors blood. The authority for saying he operated himself is found in his introduction where he says: "And, therefore, it is proper on this account in this part of the doctrine to proceed according to those things which have been manifested to me for a long time through practice and operation and by examples which in many cases are limited to discourse but in my examples and discourses I have labored with my hands themselves." William of Salicet appears to be greatly interested in the surgery of the head. He describes hydrocephalus which he treated at first by inunctions of sulphur ointment and later with the cautery. He was somewhat of an investigator for he tried to outline the sutures of the cranium by staining them with color. In skull injuries he preferred to use the chisel rather than trephine and advises extreme caution in the use of the latter. Probably the most important observation made by William of Salicet was that ulcers of the genitalia were transmitted by direct contact. He did not recognize the significance of the ulcer as part of a generalized disease but knew that it occurred and was contagious.

pter meliꝰ, vt ipſa omnia inſtrumenta ad. vi. reducã figuras & formas, quia cũ illis oĩa cauteria ad infirmitates mẽbroꝝ quaſcũqꝫ vtilia cõmode fieri poterũt.

Quorum inſtrumentoꝝ primum eſt oliuare ſeu cultellare, quod eſt valde cõmune inſtrumentum omnibus membris, cuius forma & figura eſt hæc. A.

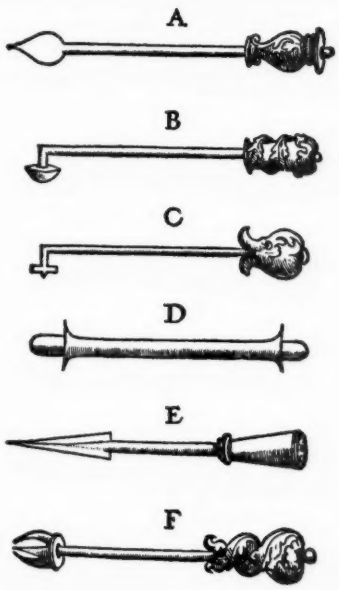
Secundum, eſt cauteriũ clauale, quod eſt ſatis cõe ad aduſtiones paruas faciendas vbicunqꝫ, ſed ſaltem in membris minutis & paruis, cuius forma eſt hęc. B.

Tertium eſt cauterium punctuale, quod eſt cõmune inſtrumentum ad aduſtiones paruas faciendas, cuius hæc eſt figura. C.

Quartum, eſt cauterium rotundum, quod eſt cõmune cauterium, ne impreſſiones profundentur in mẽbro, & neruos lædat & arterias, & venas, cuius forma eſt hæc. D.

Quintum, eſt cauterium minutum, ſeu radiale, qđ eſt cõe cauteriũ pueris, cuius forma et figura hęc eſt. E.

Sextum, eſt cauteriũ triangulatum, qđ eſt ꝓprium anchaꝝ cauteriũ, & põt fieri quum indigebis multiplicatione ꝓforationũ in loco, cuius forma eſt hęc, F.



Sciendum eſt, quod omnis locus, in quo fit dolor, & nõ reſoluatur beneficio purgationum, videlicet per vnctiones ſeu emplaſtrationes, poteſt ſecure cauterizari: & ſi locus doloroſus fuerit neruoſus, vt eſt genu aut cubitus vel ſpina, nõ perforetur ibi cum cauterio ſpiſſitudo totalis ipius cutis, ne neruus ſeu arteria, aut radix neruoꝝ aliqua lædatur; Sed hac conſideratione cautela & aduertentia habita per medicũ ſolertem, ſecure omnis locus cauterizetur in ſpiritualibus infirmitatibus, ſm qꝺ eis cõpetit, ſicut in dolore capitis ſaltẽ materiali fit oliuare ſeu cultellare cauterium in loco capitis, in quo terminatur digitus medius manus, qñ radix palmę manus ponitur ſub radice naſi; & extendit digitus ſurſum ſuper fronte: & debet imprimi iſtud cauteriũ vſqꝫ per totam ſpiſſitudinem cutis, vt locus bene comburatur, & vt ignis caliditas & virtus poſſit vſqꝫ ad profundũ pertranſire & ſub craneo, & cõfert iſtud cauteriũ ad coryzam & ad catarrhum, & ad multiplicationẽ & humiditatem abundãtem in cerebro, & ad dolorem dentium & oculorũ; & breuiter ad cõem ægritudinem, quæ accidit poſſibilium cerebro propter frigiditatẽ & humiditatẽ eius; ſicut paralyſis, apoplexia, lethargus, ſcotomia & huiuſmodi: fiunt ẽt cauteria ex eodẽ cauterio, & in eiſdẽ infirmitatibus, qñ primum cauteriũ non confert ſup duo cornua capitis in occipitio, & ſuper duo cornua anteriora, & in illa parte capitis poſteriori, vbi nuca oritur: Sed attende qꝺ in iſto loco, cauteriũ profundẽ imprimi non debet, ne nucæ in partibus neruoſis ibi exiſtentibus, & per cõſequens toti corpori nocumẽtum grande inferatur, & debet eſſe tale cauteriũ inſtitutum rotundũ ad modum ſigilli, aut bulli: fiunt etiã cauteria cum inſtrõ punctali extra radices aurium, in doloribus acutis illaꝝ partium: & fiunt ẽt cauteria cum cauterio minuto uel radiali in palpebris oculorum, quum mollificant ex humido ſuperfluo, immo in illo profunde imprimitur cauteriũ huius loci: fiunt ẽt cauteria duo cõſimilia ex vtraqꝫ parte colli dextra & ſiniſtra, unũquodqꝫ inter neruos colli & aurem, & euitantur ex toto ibi venæ & arteriæ ibi manifeſtæ et apparentes, & potiſſimum illa propter lachrymas & alias ægritudines humidas materiales oculoꝝ, & propter paralyſim ex vitio nucæ factã, et eius ortus potiſſime: fiunt ẽt cum inſtrõ cultellari, vel clauali, qđ melius eſt: In titilico uero cum cauterio punctali, fit cauterium punctale vnum propter dolorẽ humeri: cum cauterio rotundo, fiunt cauteria in ſpina, quæ nõ imprimunt propter multitudinẽ neruorum: & fit illud propter gibboſitatem & dolores ſpinæ, vel renum: Cum cauterio ẽt rotundo fiunt tria cauteria in pectore, & ſpecialiter in aſthmate, & empymate, & hmõi: Et ſub vmbilico in ore ſtomachi fiunt cauteria cum cauterio clauali, & imprimitur mõ medio. Ad hydropiſim & colicam, & ſuper hepar et ſplene, fiunt cauteria clauala & oliuaria, propter oppilationes & eorũ dolores: In inguine vero fiunt cauteria minuta, ꝓpter dolores veſicæ, & propter colicã, & ſuper caudam cum eodẽ inſtrõ, vel clauali, propter dolorẽ illius loci: Super ancha vero fiunt cauteria tria circa nocumẽtum eius, cum inſtrõ tertio: & poſſunt ex lateribus fieri duo cauteria cum oliuari in eodẽ loco, propter eandem cauſam: fiunt ſub genu & in concauitate eius inter illas duas chordas cauteria rotunda ſiue clauata ꝓpter dolorẽ genu, ex materia ibi præſenti, aut ꝓpter cõplexionem frigidã. In planitie vero pedis inter auricularem digitum et anularem, aut inter pollicem & indicẽ pedis fiunt, propter dolorem materialẽ & propter podagrã ſaltem frigidã, cauteria punctualia ſeu minuta, & aliqñ cultellaria, ſm qꝺ infirmus fuerit fortis aut debilis, aut patiens vel impatiẽs: & fiunt huiuſmodi cauteria per eandẽ cauſam in loco domeſtico, & ſylueſtri

REVIEWS OF NEW BOOKS

THE book on *Chronic Nasal Sinusitis*[1] by Watson-Williams is a treatise on the general manifestations of chronic suppurative nasal sinus disease. It is illustrated with case histories drawn from the author's personal experiences. Focal sepsis is particularly stressed, the theories of Rosenow and Billings and the local immunization theory of Besredka being used. Pathogenesis is discussed fully as pertaining to nasal sinus disease. The author's method of exploral suction technique whereby a syringe is passed into the sinus to aspirate contents for cultural purposes is described in detail.

J. D.

EVERY physician knows the frequency and seriousness of burns and yet comparatively little has been written on this important subject. The authors of *Burns*[2] present an excellent monograph to supply this hiatus in the surgical literature. Their material consists in a large part of a résumé of what has been written on burns and the reader is given numerous references on any part of the subject which he cares to consult more fully.

The book is well organized. The first part is devoted to the fundamental facts concerning burns and scalds and has a discussion as to the various theories in regard to the etiology of duodenal ulcer in cases of burns and the cause of death from burns. The second part treats of the management of thermal burns. In the preface, the authors state that they have probably not given to the tannic acid treatment space commensurate with its value, and the reviewer agrees with them. They also suggest the advisability of a separate chapter on burns and scalds in children. These additions would add much to any future edition.

In discussing the matter of contractures following burns it might have been advisable to have inserted a paragraph emphasizing the responsibility of the surgeon in preventing these deformities and the imperative necessity of using the proper splinting and extension methods from the earliest possible moment. In part three, regional burns are considered and chapters are devoted to burns produced by such specific agents as electricity, lightning, roentgen rays, radium, chemicals, and war gases. The closing chapter deals with the medico-legal aspect of burns and scalds.

The book is printed in large, readable type and the illustrations are satisfactory. The book should be of great interest to industrial surgeons; it is not unworthy of a place in any surgeon's library.

ALBERT H. MONTGOMERY.

[1] CHRONIC NASAL SINUSITIS; AND ITS RELATION TO GENERAL MEDICINE. By Patrick Watson-Williams. New York: William Wood and Company, 1930.

[2] BURNS; TYPES, PATHOLOGY AND MANAGEMENT. By George T. Pack, B.S., M.D., and A. Hobson Davis, B.S., M.D. Philadelphia and London: J. B. Lippincott Company, 1930.

THE ninth edition of the well known textbook[3] for nurses by De Lee has been completely revised with new illustrations added and the subject matter brought down to date. The author has spared no effort in making the work brief and yet comprehensive enough for its needs. The chapters on anatomy, physiology of labor, and conduct of labor including all operative procedures are well treated with excellent illustrations. While great stress is laid on the conduct of labor as carried out in the modern maternity hospital, the author has not lost sight of the fact that a great many patients are still cared for in their homes and strict rules are laid down for the successful management of such cases.

The chapters on the puerperium, both as regards mother and baby, are excellent. Great emphasis is placed on puerperal sepsis and its prevention, an important subject on which the author has taught and written for many years. The text is well worthy of the writer and embodies his high principles of teaching and practice over a long period of years; it is highly recommended for nurses and teachers of nurses.

E. L. CORNELL.

THE new edition of the textbook[4] of histology by Jordan differs but little from recent ones; in fact, since its beginning the descriptive matter, except for minor changes, has remained in the original pattern and pagination. A little has been done from time to time toward the replacement of unsatisfactory illustrations, but some of the illustrations could still be improved. Since Maximow has published his new book which has superb illustrations, it is hoped that Jordan and his publisher will be stimulated to effect a real improvement.

The descriptive material has always been simple, clear, and logical. Certain small parts are slightly prolix. Functional correlations are treated very unevenly, many important organs (e.g., eye, lung, liver, kidney) receiving little or no comment while other problematical organs (e.g., spleen, thymus, pineal body) are allotted nearly a page of discussion. References to current literature are also uneven, the introduction oftentimes of controversial matter of doubtful significance being no less remarkable than the omission of contemporary work of the greatest importance.

The reviewer would not wish to appear too critical of this work; he has used it in his classes almost continuously since the first edition. During this period it has remained probably the most generally useful student text in the English language. If it is to retain this position against current competition a genuine revision of the text and an improvement in the

[3] OBSTETRICS FOR NURSES. By Joseph B. De Lee, A.M., M.D. 9th ed. rev. Philadelphia and London: W. B. Saunders Company, 1930.

[4] A TEXT-BOOK OF HISTOLOGY. By Harvey Ernest Jordan, A.M., Ph.D. 5th ed. New York and London: D. Appleton and Co., 1930.

quality of the illustrations will doubtless be necessary. L. B. A.

IN the excellent monograph on *The Pathology of Diabetes Mellitus*[1], pathological findings are correlated with clinical studies. Use has been made of tissue removed surgically, and the author has kept in mind the idea of prevention of diabetes and its complications. As a result the book is concerned almost as much with the living as with the dead and is of as much interest to the internist and surgeon as to the pathologist. A resurvey of the pathology of diabetes mellitus is timely in view of the altered prognosis made possible by insulin and because of the increasing importance of the complications.

In addition to a review of the major contributions to the subject, the author offers tables of his own and conclusions based on 300 autopsies of cases definitely diagnosed as diabetes. It is significant that arteriosclerosis was observed in every case, regardless of age, in which the diabetes had been present for 5 years or more. The early formation of atheromatous plaques is explained on the hypothesis that there occurs a gradual accumulation of lipoid derived from lipoid laden plasma after the intima has been made permeable by such conditions as hyperglycæmia and acidosis. Modern therapy which has permitted a steady approach toward a normal, balanced diet offers the hope that premature arteriosclerosis can be prevented. In the author's 300 cases uncomplicated coma was the cause of death in 53, and coma associated with sepsis in 38 cases. Of particular importance is the fact that, of 259 cases in which the pancreas was available for study, this organ appeared normal in 69 (27 per cent). The various hypotheses that might account for this puzzling finding are discussed. This book will be of value to all who are interested in any phase of diabetes. WALTER H. NADLER.

THE second edition of *Intestinal Tuberculosis*[2] by Brown and Sampson is a real contribution to tuberculosis literature. This contribution consists of two extremely important points: First, intestinal tuberculosis is the most frequent complication of pulmonary tuberculosis and is present in over half of all cases. Tuberculous enteritis in the past was diagnosed only in cases of far advanced ulceration of the intestines. Likewise, the treatment in the past when applied to such cases was universally of no avail. Second, this book not only gives a detailed, fairly accurate method of diagnosing early ulceration of the intestines but also gives methods of treatment which in a fair percentage of cases is, to say the least, helpful.

While a large part of this book is used in itemizing the various steps leading up to the Brown and Sampson method of diagnosis and treatment, there is enough that is really new to make it necessary that this book be known to every general internist and be a part of the library of every X-ray and tuberculosis specialist. JAMES A. BRITTON.

THE well known *Rose and Carless' Manual of Surgery*[3] makes its new appearance in its latest, the thirteenth edition. The crowding into one volume of all of the existing surgical knowledge is a prodigious task. The fact that it is intended for students imposes upon the authors further strictures and limitations. Rigorous judgment in the selection of subject matter and the proper emphasis on the essential as well as the elimination of the superfluous and controversial, are all called into play.

With due regard to the evolution of surgical practice and surgical thought the authors stress the importance of study of the initial symptoms rather than of terminal phenomena. They dwell more upon the laboratory methods of diagnosis than the minute details of operations. The arrangement of the subject matter follows the plan used in the preceding editions. The only innovation is to be found in the addition of a separate chapter on "Tropical Surgery" written by Sir Frank Powell Connor.

The textbook, since its first edition in 1898, has been regarded by teachers of surgery, both here and in England, as a standard text. After an experience with a number of books the reviewer still feels that Rose and Carless meets the requirements of a surgical text for students perhaps better than any other single work in English. GEORGE HALPERIN.

THIS first edition by the Master of Rotunda Hospital is, in its plan, an abridgment of Tweedy and Wrench's *Practical Obstetrics*,[4] now being edited by the present author. It is rather a text and guidebook of practical midwifery for nurses in hospital, out-patient, and private practice, than a nurses' manual of obstetrics. More responsibility to be borne by the nurse is implied than the American profession generally encourages.

It is too easy to criticize destructively, and one must be cautious in the consideration of a general method such as has been adopted by the author and his predecessors. However, the teaching of the nurse's use of a vaginal douche in normal labor where, with unruptured membranes, there is a septic discharge; before all obstetric operations; for a rigid cervix in uterine inertia; and many other analogous points of advice, will probably not appeal so much to some as to the Rotunda trained. One feels that the described left lateral position for delivery should share some consideration with the merely mentioned dorsal, and that other anæsthetics

[1] THE PATHOLOGY OF DIABETES MELLITUS. By Shields Warren, M.D. With a foreword by Elliott P. Joslin, M.D. Philadelphia: Lea & Febiger, 1930.

[2] INTESTINAL TUBERCULOSIS; ITS IMPORTANCE, DIAGNOSIS AND TREATMENT, A STUDY OF THE SECONDARY ULCERATIVE TYPE. By Laurason Brown, M.D., and Homer L. Sampson. 2d ed rev. Philadelphia: Lea & Febiger, 1930.

[3] ROSE AND CARLESS' MANUAL OF SURGERY: FOR STUDENTS AND PRACTITIONERS. By Cecil P. G. Wakeley, F.R.C.S. (Eng.), F.R.S. (Edin.), and John B. Hunter. M. C., M. Chir. (Cantab.), F. R. C. S. (Eng). 13th ed. New York: William Wood and Company, 1930.

[4] PRACTICAL MIDWIFERY FOR NURSES. By Bethel Solomons, M.D., F.R.C.P.I., M.R.I.A. New York and London: Oxford University Press, 1930.

at least be named in addition to the repeatedly recommended ether and chloroform. The book has too many splendid points in its presentation to nurses of well tested methods, to be considered anything but a first rate work in its class.

Well illustrated, thoroughly indexed, systematically presented, containing a glossary of terms, this 354 page book will, and justly should, find a grateful reception by nurses and their instructors in Great Britain. The exactness of the instructions in general, the explicitness of orders to be carried out in relation to the Rules of the Central Midwives Board (which Rules with notes occupy an appended chapter) will relieve many a "monthly" and "district" nurse of unnecessary worry. The format, characteristic of these publications, is very pleasing.

C. B. S. EVANS.

THE appearance of a new edition of any internationally employed standard textbook is probably hailed, initially, by a reception more of curiosity than of expectation of magazine-like timeliness of its material. However, when one turns to the bibliography of a chapter on pregnancy tests in a 1,157 page text and finds there a foreign reference to Aschheim, dated 1930, he experiences a sensation of acclaim in appreciation of an author's efforts and his publisher's achievements. Such an up-to-dateness is necessary, however, in the case of Whitridge Williams,[1] who, as an acknowledged world leader in the campaign of obstetric conservatism, must be ready with his ammunition to aid in the universal drive for safer expectant motherhood.

The new pages from physiology, anatomy, and pathology to the toxæmias, anæsthetics, liver therapy, and low cæsarean, bear witness to the thoroughness of the revision of this edition. The statement of the author, claiming that scarcely a page remains unchanged, appears valid when editions are compared. The book is a careful balance between the necessary didactic—the result of the author's teaching experience—and the practical—the outcome of 36 years' obstetric practice.

It is said that in 1903, when the first edition was being prepared, Dr. Williams submitted his manuscript to a colleague in the college English department, to edit grammatically. The present volume, similarly, could be used as a working manual of good usage. To the profuseness of illustrations have been added forty plates, distinguished by the photographic quality attained by Max Broedel. The new format adopted, evidences complete resetting and retyping, the sheets being larger, the lines longer, the pages more legible.

C. B. S. EVANS.

THE author of *Aphasia in Children*,[2] a psychologist who conducts a speech clinic at Manchester, England, encountered 10 children who were sent to him under the label of "congenital aphasics." On closer examination it was found that 6 of them "suffered from a condition of partial deafness hitherto unknown and unstudied." This condition is called "high-frequency deafness."

The traditional methods of testing hearing, we are told, are unsuitable for an analysis of high-frequency deafness. The tuning forks which are the standard instruments for such hearing tests register, in their clinical routine application, only the frequencies from 64 to 256 vibrations per second. Within this range the hearing of the "aphasic" children showed no defect. The defect came to view only when frequencies from 512 to 8,192 were applied. Besides the vibratory frequencies, the intensity steps must be taken into account.

The phonograph audiometer was used to determine the hearing range of the "aphasic" children. It developed that "children incapable of hearing the loudest sounds producible by the tuning fork, or indeed any of the apparatus used hitherto, had hearing, though limited."

A modification of the phonograph audiometer, specially designed by the author, had added advantages over the original instrument.

The title of the book is rather misleading. In its diagnostic and therapeutic sections, it deals in great detail with hearing defects and gives very little material on speech defects. The problems of the aphasias are covered only in the chapter on literature. Here, however, the author shows himself well informed—surprisingly well for a non-medical writer—on the basic elements of the subject. The book is of definite value for the otologist and for the special worker in the field of speech disturbances.

J. K. C.

THE book on *Diathermy*[3] by Dr. McKenzie is a summation of his personal experiences as applied to diseases of the ear, nose, and throat supplemented with all the literature available and the experience of other men. The book discusses diathermy fully but fortunately not too technically so that one may easily grasp the fundamentals.

Dividing the book into chapters dealing with (1) medical diathermy and its application to such cases as ozena, middle ear diseases, etc.; (2) surgical diathermy such as the removal of malignant growths, etc.; (3) surgical diathermy in cancer, both eradicable and non-eradicable, the author gives the technique and statistics on results obtained in a variety of cases. Some of his results have been very satisfactory, others not. The book is well written and is a lucid explanation of the best methods of application of diathermy to disease of the ear, nose, and throat. It will be a most valuable one to the busy practitioner seeking a ready reference to the latest uses of diathermy.

JOHN F. DELPH.

[1] OBSTETRICS; A TEXTBOOK FOR THE USE OF STUDENTS AND PRACTITIONERS. 6th ed. rev. By J. Whitridge Williams. New York and London: D. Appleton and Company, 1930.

[2] APHASIA IN CHILDREN. By Alex. W. G. Ewing, M.A., Ph.D. With an Introduction by E. D. Adrian, M.D., F.R.C.P., F.R.C.S. London: Oxford University Press, 1930.

[3] DIATHERMY, MEDICAL AND SURGICAL, IN OTO-LARYNGOLOGY. By Dan McKenzie, M.D., F.R.C.S.E. New York: The Macmillan Company, 1930.

ALTHOUGH the reviewer finds no change in the contents of the second edition from the first edition of *The Action of Muscles*,[1] except the addition of a chapter on the erect posture, he welcomes the opportunity to praise Dr. MacKenzie's book unreservedly. This is by all odds the most important volume dealing with muscle action and re-education. The author has not only engaged in the practice of physical therapy and superintended the rehabilitation of large numbers of disabled British soldiers, but he is also a comparative anatomist and director of the Australian Institute of Anatomy, and he carries the viewpoint of the evolution of function and structure into every chapter of his book. After an initial chapter on principles of muscle action and the testing of muscle action, the following fourteen chapters deal with descriptions of the action of the various muscle and nerve-muscle groups, with one chapter on the anatomical considerations in joint fixation. This small volume makes an ideal desk reference book. On every problem of disturbed muscle function and re-education, the author has some illuminating or stimulating comment to make.

JOHN S. COULTER.

[1] THE ACTION OF MUSCLES: INCLUDING MUSCLE REST AND MUSCLE RE-EDUCATION. By Sir Colin MacKenzie, M.D., F.R.C.S., F.R.S. (Edin.). New York: Paul B. Hoeber, Inc., 1930.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

LES DIAGNOSTICS ANATOMO-CLINIQUES DE P. LECÈNE; RECUEILLIS PAR SES ÉLÈVES. I. GÉNÉRALITÉS. By P. Pavie. Lésions du Sein. By P. Moulonguet. Paris: Masson et Cie, 1930.

CHININ IN DER ALLGEMEINPRAXIS UNTER BERUECKSICHTIGUNG PHARMAKOLOGISCHER BEFUNDE. By Dr. Med. Fritz Johannessohn. Amsterdam-W: Bureau Tot Bevordering Van Het Kinine-Gebruik, 1930.

PHYSICIANS' MANUAL OF BIRTH CONTROL. By Antoinette F. Konikow, M. D. New York: Buchholz Publishing Company, 1931.

SURGICAL NURSING. By Hugh Cabot, M.D., C.M.G., F.A.C.S., and Mary Dodd Giles, B.S., R.N. Philadelphia and London: W. B. Saunders Company, 1931.

VEIT'S HANDBUCH DER GYNAEKOLOGIE. 3d rev. enlarged ed. Edited by W. Stoeckel and collaborators. First half, vol. vi on Die Erkrankungen der Scheide. By Dr. Ludwig Nuernberger. Munich: J. F. Bergmann, 1930.

LOVETT'S LATERAL CURVATURE OF THE SPINE AND ROUND SHOULDERS. 5th ed. rev. and edited by Frank R. Ober, M.D., and A. H. Brewster, M.D. Philadelphia: P. Blakiston's Son & Co., Inc., 1931.

CANCER DU PANCRÉAS. By Ch. Oberling and M. Guérin. Paris: Gaston Doin & Cie, 1931.

AN INTRODUCTION TO PHARMACOLOGY AND THERAPEUTICS. By J. A. Gunn, M.D., D.Sc. (Edin.), M.A. (Oxon.). 2d ed. New York and London: Oxford University Press, 1931.

THE TREATMENT OF CHRONIC DEAFNESS BY THE ELECTROPHONOIDE METHOD OF ZUEND-BURGUET. By George C. Cathcart, M.A., M.D. 2d ed. New York and London: Oxford University Press, 1931.

FRACTURES; AND THEIR COMPLICATIONS. By George Ewart Wilson, M.B. (Tor.), F.R.C.S. (Eng.), F.A.C.S. New York: The Macmillan Company, 1931.

AN INTRODUCTION TO GYNECOLOGY. By C. Jeff Miller, M.D. St. Louis: The C. V. Mosby Company, 1931.

SELECTIONS FROM THE PAPERS AND SPEECHES OF JOHN CHALMERS DACOSTA, M.D., LL.D. Philadelphia and London: W. B. Saunders Company, 1931.

DIE TECHNIK DES UNGEPOLSTERTEN GIPSVERBANDES. By Dr. Fritz Schnek. Geleitwort by Dozent Dr. Lorenz Boehler. Vienna: Wilhelm Maudrich, 1931.

THE THEORY OF OBSTETRICS; A FUNCTIONAL STUDY OF CHILD-BEARING, BASED ON A NEW DEFINITION OF NORMAL LABOUR AND ON A NEW THEORY OF UTERINE INERTIA, AND ILLUSTRATED BY A DETAILED STATISTICAL ANALYSIS OF 100 CONSECUTIVE LABOURS, AND SOME RECORDS OF CASES OF PAINLESS LABOUR. By M. C. DeGaris, M.D. New York: William Wood and Company, 1931.

ROENTGEN INTERPRETATION; A MANUAL FOR STUDENTS AND PRACTITIONERS. By George W. Holmes, M.D., and Howard E. Ruggles, M.D. 4th ed. rev. Philadelphia: Lea & Febiger, 1931.

A TEXTBOOK OF SURGERY. By John Homans, M.D. Springfield, Illinois and Baltimore, Maryland: Charles C. Thomas, 1931.

THE INBORN FACTORS IN DISEASE; AN ESSAY. By Archibald E. Garrod, K.C.M.G., D.M. LL.D., F.R.C.P., F.R.S. London and New York: Oxford University Press, 1931.

COLLECTION DES ACTUALITÉS DE MÉDECINE PRATIQUE. Chirurgie Esthétique Pure (Technique et Résultats). By Raymond Passot. Paris: G. Doin & Cie, 1931.

TRANSACTIONS OF THE AMERICAN GYNECOLOGICAL SOCIETY. Volume 55. For the Year 1930. Edited by Floyd E. Keene, M.D. St. Louis: C. V. Mosby Company, 1931.

LES DIAGNOSTICS ANATOMO-CLINIQUES DE P. LECÉNE: RECUEILLIS PAR SES ÉLÈVES. II. APPAREIL GÉNITAL DE LA FEMME. PREMIÈRE PARTIE. By P. Moulonguet and S. Dobkevitch. Paris: Masson et Cie, 1931.

THE LETTERS OF DR. BETTERMAN. By Charles Elton Blanchard, M.D. Youngstown, Ohio: Medical Success Press, 1931.

SOME PRINCIPLES OF CANCER STATISTICS RESEARCH. By Frederick L. Hoffman, LL.D. Prudential Press, 1931.

SAN FRANCISCO CANCER SURVEY; SIXTH PRELIMINARY REPORT. (Thirteenth, Fourteenth, Fifteenth and Sixteenth Quarterly Reports). By Frederick L. Hoffman, LL.D. Newark, N. J.: The Prudential Insurance Co. of America, 1931.

A HANDBOOK FOR SENIOR NURSES AND MIDWIVES. By J. K. Watson, M.D. (Edin.). 2d ed. New York and London: Oxford University Press, 1931.

THE DIET BOOK; FOR DOCTOR, PATIENT AND HOUSEWIFE. With Specimen Menus for One Week and Recipes. By Marguerite Requa Rea (Mrs. Alec. L. Rea). With a foreword by Sir James Purves-Stewart, K.C.M.G., C.B., M.D. (Ed.), F.R.C.P. (Lond.). London: Oxford University Press, 1931.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

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THE 1931 CLINICAL CONGRESS IN NEW YORK AND BROOKLYN

UNDER the leadership of strong and representative committees, the surgeons of New York and Brooklyn are developing an attractive program of clinics and demonstrations for the entertainment of Fellows of the College and their guests at the twenty-first annual Clinical Congress of the American College of Surgeons, October 12-16, 1931. All departments of surgery will be represented therein—general surgery, gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat, and mouth.

Operative clinics and demonstrations in the hospitals are scheduled for Monday afternoon at 2 o'clock and for the mornings and afternoons of each of the four following days. A preliminary clinical program will be published in the next issue of SURGERY, GYNECOLOGY AND OBSTETRICS.

In the clinical program special emphasis will be laid on modern methods in the treatment of fractures; treatment of cancer by surgery, radium, and the X-ray; electrosurgery; rehabilitation of patients injured in industrial accidents, etc.

Programs for a series of evening meetings are being prepared by the Executive Committee of the Congress. At the presidential meeting on Monday evening, the president-elect, Dr. Allen B. Kanavel, of Chicago, will be inaugurated and deliver the annual address. Another feature of that session will be the John B. Murphy oration in surgery to be delivered by Arthur H. Burgess, M.B., F.R.C.S., Manchester, England, professor of clinical surgery in Victoria University, Manchester, and president of the British Medical Association. At the scientific meetings on Tuesday, Wednesday, and Thursday evenings, eminent surgeons of the United States and Canada with distinguished visitors from abroad have been invited to present papers dealing with surgical subjects of present-day importance. The annual convocation of the College will be held on Friday evening at which the 1931 class of candidates for fellowship in the College will be received.

Subcommittees in charge of the section on surgery of the eye, ear, nose, and throat have arranged for two evening sessions at the Academy of Medicine at which papers and demonstrations of special interest to practitioners in those special branches of surgery will be presented.

General headquarters for the Clinical Congress will be established at the new Waldorf-Astoria Hotel, located on Park avenue between 49th and 50th streets. This magnificent new hotel, with more than two thousand guest rooms, which will be opened on October 1st, offers unusual facilities for sessions of the Clinical Congress. Surgeons who have attended the three previous sessions of the Clinical Congress in New York when headquarters were at the old Waldorf-Astoria will find in the new hotel all the comforts and facilities of the old hotel with many added attractions and conveniences. The grand ballroom and other large rooms and foyers on the second floor of the hotel have been reserved for the exclusive use of the Congress for scientific meetings, conferences, film exhibitions, registration and ticket bureaus, bulletin boards, executive offices, scientific and technical exhibitions, etc.

The Congress opens at 10 o'clock on Monday morning with the annual hospital conference in the grand ballroom of the Waldorf-Astoria. The hospital conference will continue on Tuesday and Wednesday with an interesting program of pa-

pers, round table conferences, and practical demonstrations dealing with problems related to hospital efficiency, planned to interest surgeons, hospital trustees, executives and personnel generally. An invitation is extended to all persons interested in the hospital field to attend this conference.

Other important features of the Congress include a symposium on cancer and conference on cancer clinics, hospitals, and institutes; daily exhibition of surgical films; an all-day conference on traumatic surgery in which leaders in industry, education, and labor, together with representatives of insurance companies, surgeons, and hospital administrators, will participate.

An application for reduced railway fares on account of the meeting in New York and Brooklyn is pending before the railroad traffic associations, and it seems assured that a rate of one and one-half the regular first-class one-way fare will be in effect from all points in the United States and Canada.

Attendance at the New York-Brooklyn session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of $5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non-transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

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